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ON THE COVER

A NEW type of scaffold or staging rides up and down the wire rope on which it is suspended, emulating the antics of a spider. Powered by either a compressed-air or electric motor, it has already gained popularity in the West where it was developed and introduced. Our cover picture shows one of the units poised in thin air underneath the new Tacoma, Wash., bridge that replaces the one that acquired the name of Galloping Gertie because it writhed and buckled in a 1940 storm until it destroyed itself. Several of these Spider Stagings are used for painting the structure. By utilizing an extra-large drum, enough cable can be carried to permit one of the aerial platforms to travel from top to bottom of the 525-foot towers.

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IN THIS ISSUE

SPELEOLOGISTS, of which George F. Jackson is one, conduct scientific studies of caves. Many things are, of course, found in these caverns, but one would not suspect that they were at one time the source of something important to the preservation of the nation. That was the case, though, as told by Mr. Jackson in our first article.

•

IOWA STATE is proud of the carillon that has sent forth melodies for half a century. Two students of the college compiled the account of these bells that starts on page 161.

•

PART two of *Farm Mechanization* (page 166) describes some of the modern contrivances that assist agriculturists. A few are included that make use of compressed air at varying pressures.

•

IT IS seldom that two problems can be solved at one stroke, but it happened in Texas. Southern Minerals Corporation had a supposedly depleted oil sand and more liquefied petroleum gas (LPG) than it could conveniently store aboveground. Now it injects the surplus LPG into the oil sand. When recovered as needed it brings along with it daily an average of 24 barrels of crude oil that is scoured out of the formation. Page 171.

Compressed Air Magazine

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OLD NITER WORKINGS

Views inside Mammoth Cave, Kentucky, showing wooden vats and piping used nearly 150 years ago to leach mineral from the nitrous dirt. Water was brought in through pipes bound at the joints with iron bands.

PHOTOS, NATIONAL PARK CONCESSIONS

Niter Caves

Before the Colonists Could Keep Their Powder Dry They Had to Make It

George F. Jackson

AN INTERESTING but little-known chapter in the history of the American explosives industry concerns the "mining" of saltpeter in limestone caves. As one of the essential ingredients of gunpowder, saltpeter was a much-needed mineral, and the finding of a home source of supply contributed to our winning the War of 1812 and aided the colonists in other ways. Gunpowder was required for the weapons that both protected them from the Indians and enabled them to procure certain foods so essential to their well-being. It also served in blasting excavations and quarrying stone for construction projects.

Decaying vegetable matter and animal excrement are high in nitrogen. Some of the cave deposits contained potassium or sodium salts, notably nitrates and carbonates, but the yield of potassium nitrate (saltpeter) was normally low. However, some chemically inclined pioneer figured out that pouring water through cave dirt and then through wood ashes would produce a reasonably concentrated solution of saltpeter which could be reduced to crystals by evaporation. Wood ashes are rich in potassium or potash, the latter term having come from the pots that were used to evaporate the wood-ash leachings.

As early as 1775 a book entitled *Several Methods of Making Saltpeter* was published and recommended to the inhabitants of the United Colonies by their representatives in Congress. It contained an appeal by John Hancock, then President of Congress, to manufacture and stock saltpeter, and is considered

by some authorities to be the first plea to develop the science of powder making in the Colonies and the forerunner of textbooks on the subject. The methods described were based largely upon old European practices.

The pioneers discovered that potassium nitrate could be obtained from the nitrous dirt in the many caves and rock shelters in the Appalachian region of this country and made good use of that circumstance. Later, when Daniel Boone and following explorers penetrated the wilderness of Kentucky and neighboring states the transportation of gunpowder over difficult trails and dangerous mountain passes was a hazardous operation. Consequently, supplies were often meager or nonexistent.

Because powder was absolutely necessary to their existence, those hardy adventurers took advantage of the niter beds as they were called, and many an Indian raid was routed by bullets propelled by crude and homemade gunpowder. At first, they availed themselves of deposits found under the shelter of ledges and rock overhangs at the heads of ravines and cliffs where the niter was well protected from the rains. Despite the fact that solid masses weighing from 100 to 1500 pounds were sometimes discovered, it took three men at least one day to leach out from 50 to 100 pounds of saltpeter. For that reason the inclination was to give up a niter bed as soon as its yield grew small and to seek other sources. That led to the exploration of the numerous caverns in central Kentucky, and one historian has stated that as many as 28 were known in the region before 1800.

One in particular, the Great Cave as it was called locally, was the rumored trap of an entire family whose torch was accidentally extinguished while exploring it and who wandered around in the darkness for three days before finding the entrance again. That incident attracted the attention of a Dr. Samuel Brown of Lexington, Ky., who investigated the cavern and later made a report on it to the American Philosophical Society of Philadelphia, Pa.

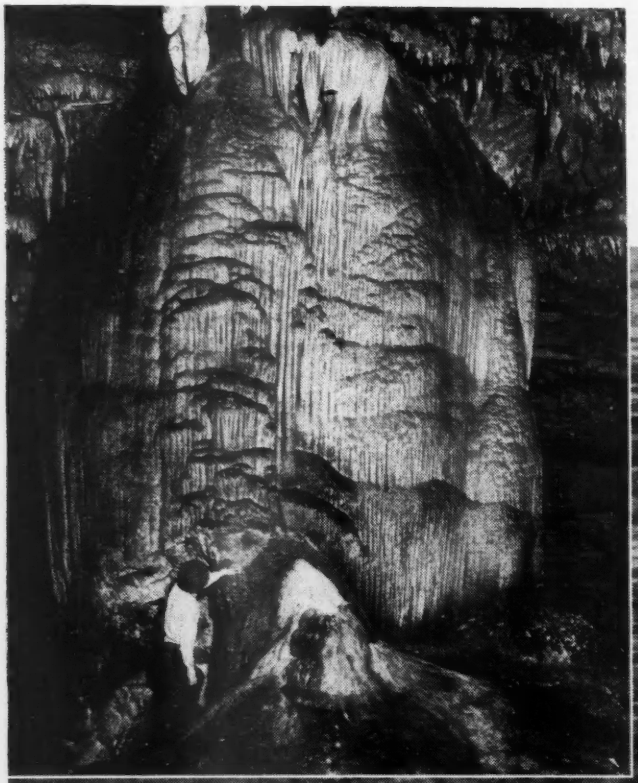
The detailed paper, read in 1806, was one of the earliest reports on the subject in this country. In it Doctor Brown described the great cave and its niter deposits "where workmen dug down fifteen feet into the soil on the floor and found it still rich in niter." It contained specific directions for preparing saltpeter which, he claimed, was far superior to that imported from Spain and India. In closing, Doctor Brown observed that "A concern for the glory and defense of our country should prompt such of our chemists as have talents and leisure to investigate this interesting subject. I suspect that we have much to learn with regard to this salt, so valuable in time of peace, so indispensable in time of war."

On the strength of that report, perhaps, the owner of one of the largest gunpowder plants in the Colonies made arrangements in 1807 to visit the saltpeter deposits of the region. It is not a matter of record that he made the trip, but history bears witness to the fact that he realized the importance of securing nitrates from domestic sources.

At the start of the War of 1812 we were cut off from foreign shipments of nitrates by England's general embargo, and under the impetus of patriotism and high prices enormous quantities of saltpeter were mined in various sections of Kentucky, Indiana and other states. Today may be seen the remains of old saltpeter workings in both Mammoth Cave, Kentucky, now Mammoth Cave National Park, and in Wyandotte Cave, Indiana—two of the world's largest known caverns. Those in Mammoth, with their old wooden pipes, leaching vats, hoppers and supports, the tracks of the oxcarts, even the hub marks worn in the sides of narrow tunnels by creaking wheels, are still in a remarkable state of preservation and much as they were left by the miners more than 140 years ago.

The excellent condition of the abandoned workings at Mammoth are attributed to the fact that operations were carried on back in the cave where the even dry temperature has prevented deterioration. This is not true of Wyandotte cavern, which was mined nearer the entrance where moisture and temperature changes have wrought destruction. Almost forgotten in the passage of time, both, nonetheless, tell the story of hard labor in dimly lighted underground chambers—labor that cannot be applauded too highly because it contributed so much towards our independence.

What is purported to be the first published account of saltpeter deposits in the United States appeared in 1819 in William McMurtrie's *Sketches of Louisville and Its Environs*. In describing Wyandotte Cave he called it the Mammoth Cave of Indiana and stated that Gen. William Henry Harrison had visited it in 1806. He quotes Harrison as saying that "there were at that time enormous lumps of some saline matter scattered over the floor, individual pieces of which . . . would have weighed from one to two hundred pounds." This is undoubtedly an exaggeration, and what Harrison referred to were probably the large piles of broken rock that still dot the passageways here and there. According to McMurtrie, the earth in the cavern "contains about five pounds of the ni-



NATURE'S HANDIWORK

Below, one of the larger chambers in Wyandotte Cave. Its size may be judged by the man on the far side who is a 6-footer. The "Pillar of Constitution," left, also in Wyandotte cavern, is one of the largest stalagmites known. It is 35 feet high and 75 feet in circumference. Many names with dates around 1812 are scratched on its fluted sides, leading to the belief that they were put there by niter miners who were active during that period.

REMAINING PHOTOS IN ARTICLE BY AUTHOR

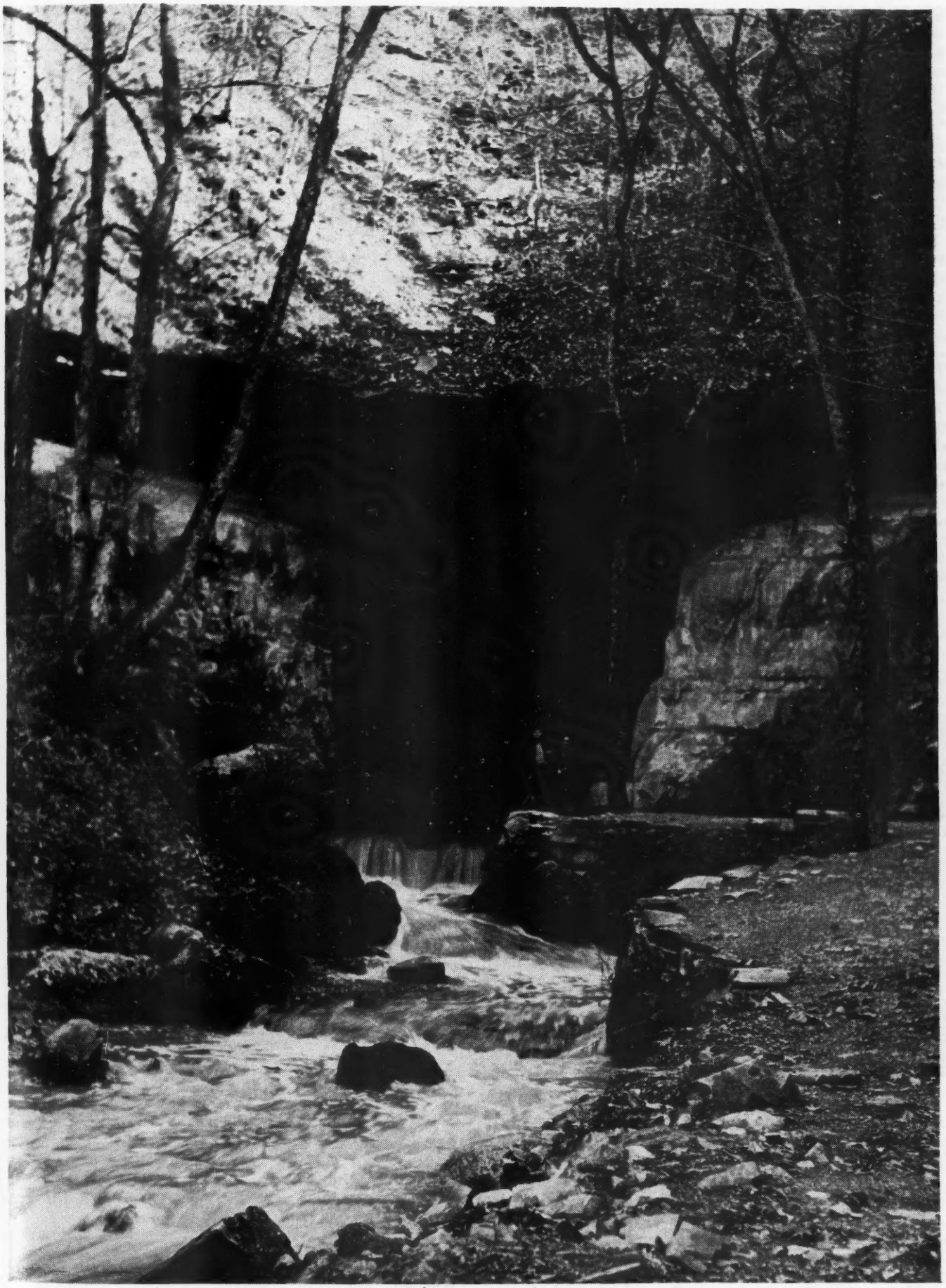
trate of lime or magnesia to the bushel, and is composed of decaying animal and vegetable matter . . . . "

At the time of the report, the cave and the land around it were in the possession of a Dr. Samuel Adams who had acquired it from the Government for the purpose of making saltpeter. The only section of the underground area then known was what is now called the Old Cave to which Doctor Adams had given the name Indiana Saltpeter Cave and, later, Epsom Salts Cave.

The next account of domestic saltpeter deposits was printed in 1820, one year after McMurtrie's book though written by Doctor Adams on February 27, 1818. It appeared in Volume I, Transactions and Collections of the American Antiquarian Society, in the form of an appendix headed, "Account of a Great and Very Extraordinary Cave in Indiana, in a Letter from the Owner to a Gentleman in Frankfort, Kentucky." In it Doctor Adams mentions the great amount of "sulphate of magnesia or epsom salts, which abounds throughout the cave in almost its whole extent . . . . The next production is the nitrate of lime or saltpeter earth. There are vast quantities of this earth and equal in strength to any that I have ever seen."

From about 1812 until 1820 Doctor Adams carried on his business of making saltpeter on an extensive scale, using the niter dirt from Wyandotte and from another cavern nearby. With the war over, however, the business of leaching the salts became unprofitable and he gave up his claim for more lucrative fields.

Down in central Kentucky, meanwhile, reports by discoverers and early explorers of the nitrous material in Mammoth Cave led to its purchase in 1811



ENTRANCE TO INDIANA CAVERN

Donaldson's Cave in Spring Mill State Park near Mitchell. Although little evidence now remains, reports handed down through the generations indicate that niter was mined there early in the last century.

by a Mr. McLean, the property, together with 200 acres around its mouth, costing him $40. Evidently, McLean kept it only a short time, for when the War of 1812 started it was in the hands of Gratz and Wilkens, enterprising men "whose agent, Mr. Archibald Miller, made a fortune for them" during the conflict. One writer quotes him as saying that the cave contained nitrous dirt "sufficient to supply the whole population of the Globe with saltpeter"!

Slave labor was used for mining and most of the heavy work outside. The niter-rich material was gathered in sacks in small and remote areas and carried to larger passageways where it was dumped in great piles from which oxcarts transported it to hoppers or to leaching vats. The latter were from 8 to 10 feet long, 4 or 5 feet wide and about as deep, and had bottoms of small logs split in half. Wooden pipes, about 10 inches in diameter and made up of 20-foot sections held together with iron bands, brought in water. After passing through the fine dirt in the hoppers, the water was channeled into small pits nearby and thence to a large reservoir from which it was pumped to the surface. The leached material was shoveled into large piles well out of the way of operations.

Reaching the outside, the concentrated water or "beer," as the workers called it, was allowed to filter through hoppers filled with wood ashes, then boiled down and put in wooden troughs for cooling. A day or so later the resultant crystals of potassium nitrate were removed for shipment to powder mills in the east.

H. C. Hovey, in his lengthy history of Mammoth Cave, said that ordinary "peter dirt" was expected to yield from 3 to 5 pounds of nitrate of lime per bushel, and that it was necessary to use "18 bushels of oak ashes, or 10 of elm, or two of ashes made by burning the dry wood in hollow trees" to produce 100 pounds of saltpeter. He also stated that the contract for saltpeter from Mammoth Cave alone totaled $20,000 for the year 1814. Another writer, John H. Farnham, reported in 1820 that 300 to 500 pounds, worth from 16 to 25 cents a pound, were made each day at an estimated cost of four cents a pound.

Many other underground chambers were mined for saltpeter during the early part of the nineteenth century but, apparently, the workings were not as extensive as those at Mammoth and Wyandotte or, if so, did not become as famous and have been forgotten even locally.

Scattered throughout the various honeycombed sections of the central and eastern states are many caverns known today as Salt Cave or Saltpeter Cave because of this pioneer industry, but most of them seem to have been operated on a comparatively small scale. Among them are Dixon's Cave, supposed to have been the original mouth of Mammoth, where the piles of rock discarded by the old miners are 30 to 40 feet high; Saltpeter Cave, ¼ mile from Wyandotte; and Donaldson's Cave in what is now Spring Mill State Park in Indiana.

During the Civil War the Confederate Government, continually faced with the possibility of having its supply of saltpeter cut off, did considerable exploiting of the South's niter caverns. Early during the conflict the Ordnance Department made plans for working the deposits, and even voiced the hope that home-produced niter could completely supplant importations of that much-needed mineral. That they attached great importance to the project is indicated by the fact that the appropriation for the production and manufacture of saltpeter in the first six months of 1863 amounted to $2,650,000.

A number of caves in Tennessee, Georgia and Virginia were mined, but were frequently shelled by Union Forces and run so inefficiently by private enterprise that government operation finally became necessary. Although the Confederates were working sixteen or more niter deposits with hundreds of men by the middle of the war, the yield was never as great as expected. Official records indicate that by June 30, 1864, the amount produced totaled 1,735,532 pounds. The fact that the best sites were in territory close to enemy lines undoubtedly prevented the South from obtaining a considerably larger supply of saltpeter during those critical days.

So it was that even the dark and mysterious caves played a part in the colorful history of the explosives industry in the United States.

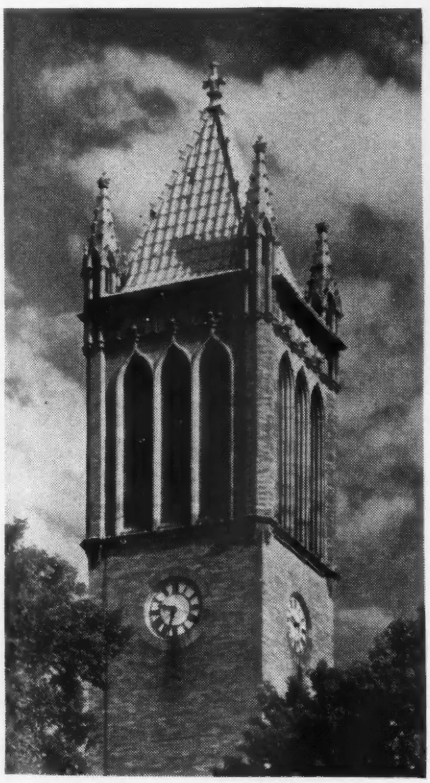
MEMENTOS OF LONG AGO

F. I. Bentley, who prowled around in Wyandotte Cave in 1801 (the earliest date thus far found), carved his name in the limestone walls in several places, but it does not appear in any of the known histories of the cavern. The illusion of raised letters was caused by holding the flashlight to one side when the picture was snapped. The cup, right, is covered with stalagmitic materials. It is estimated that it has taken 75 years to build up the deposit. The cup is not cemented to its rocky table and is used for drinking purposes.

Bells of Iowa State

Carillon Given by Former Dean Has Been Ringing Out Songs for Half a Century

Robert A. Mingus
and
Lee Diton



THE CAMPANILE

The Italian-Renaissance tower that houses the bells is 110 feet high and was built by the state in 1897. The clock was added two years later. The 36 bells are hung at and above the 75-foot level, where the openings are in the tower, which is deeply steeped in Iowa State College tradition. It figures in initiations of several school societies, and there is a pleasant custom of kissing a girl there at midnight in order to make her an "official" coed.

BALLED fists strike projecting rods, dancing feet perform on pedals, and more than 28 tons of bronze bells vibrate, sending a melody across Iowa State College campus.

The famed Stanton memorial carillon at Ames has been ringing out college, fraternity and sorority songs for more than half a century. The campanile, the tower that shelters the 36 bells, becomes a scene of intense activity every morning at 7:45 and again at 12:50 p.m. when the Carillonneur Ira Schroeder climbs the narrow, winding stairway to the keyboard of one of the oldest carillons in the United States.

In 1895, Dr. Edgar W. Stanton, junior dean and vice-president of the college, desired to build a lasting monument to his wife, Margaret McDonald Stanton, the institution's first preceptress. When he made known his wish to present the college with a set of ten chimes, the State of Iowa agreed to construct the campanile to house the carillon.

The tower was completed in 1897 and the bells were installed in 1899. Known as the Margaret Chimes, the instrument was imported from the John Taylor & Company foundry at Loughborough, England, and, strangely enough, was the first scientifically tuned group of bells to come to the United States from Europe. The original ten weigh 17,000 pounds; individually, they vary from 450 to 3584 pounds. The cost was about $7500. According to law there was a duty of $3000 payable on the shipment. However, Senator William B. Allison, of Dubuque, Iowa, at that time chairman of the Ways and Means Committee, influenced Congress to permit the carillon to enter the country duty-free.

After Dean Stanton's death, 26 more bells were added to the Margaret Chimes with funds provided in his will. They, too, were obtained from John Taylor & Company and were placed in the campanile in 1929. The inaugural service of

the much enlarged memorial carillon was marked by the playing of the bells by Anton Bries of Belgium, at that time acknowledged to be the world's master carillonneur.

The 26 bells weigh 40,069 pounds and range individually from 29 to 5737 pounds. They were poured of bronze composed of thirteen parts of copper to four parts of tin and are valued at more than a dollar a pound. The largest one is 4 feet 9 inches high and 5 feet 4 inches in diameter and has the same pitch as the second "B" flat below middle "C." The thickest part of the bell is called the sound bow and is the principal zone of vibration producing its fundamental tone. Each was brought to pitch by reaming out the inner surface of the bow.

The carillon has a range of three octaves and is played from a "baton" keyboard of 36 hand rods and by 17 pedals. The rods, which compose the keyboard situated in the center of the clock floor of the tower, are connected to the clappers by tempered-steel wires that also were made in Great Britain. Usually weighing about one-tenth as much as its bell, the clapper is mounted on an adjustable rocker-arm for ease of playing. The heavier clappers are counterbalanced for the same reason. Those in the smaller bells are attached to springs to permit of rapid repetition—to obtain the tremolo effect which is one of the important distinctions between a chime and a carillon.

Because the large bells require a blow of about 10 pounds for the full tone, they are usually played by the pedals, which duplicate the seventeen hand rods on the left end of the keyboard. This mechanism, known as the Ellacomb chiming apparatus, is a considerable advance over the method used before 1929. Prior to the introduction of the keyboard and pedals, carillons were played by means of ropes hanging from the bell chamber.

The bells are beautiful in appearance. In addition to their graceful shape and decorative scrollwork, each of the original ten has an inscription, nine of which read as follows:

And soften down the rugged road of life.
—Kirk White

Ring merrily, ye chimes, evermore.
—Charles MacKay

Harmonizing this earth with what we feel above. —Shelley

My language is understood all over the world.
—Hayden

Every deed of goodness done is like a chord set in the heart. —Thomas Maclelan

Sweetly on the evening air
Sounds the vesper chime of prayer
And rings a thousand memories
At vesper and at prime. —Coxe

Music is the child of prayer,
The Companion of religion.
—Chateaubriand

A woman that feareth the Lord, she shall be praised. —Proverbs xxi:30

Then pealed the bells more loud and deep;
God is not dead; nor does He sleep;
The wrong shall fail
The right prevail—
With peace on earth, good will to men.
—Longfellow

TWO-FISTED JOB

Stripped for action because his working place is hot in spite of good insulation. Carillonneur Ira Schroeder brings clenched fists down on the rods that constitute the keyboard of the clavier. Unseen are seventeen foot-actuated levers used to play the larger bells, which require a 10-pound blow. Steel wires run from the rods and pedals to the bell clappers, which normally weigh about one-tenth as much as their bells. A clapper moves about 1 inch at each stroke and hits the inside of the bell near the bottom, where it has its greatest diameter.

The Italian-Renaissance campanile was designed by George E. Hallet, a Des Moines architect, and Anson Marston, the late dean emeritus of Iowa State College and past president of the American Society of Civil Engineers, was superintendent of construction. It was built at a cost of $6385. In 1899, two years after its completion, the Iowa State College clock was purchased and installed at an outlay of $2200. The original was a Seth Thomas timepiece, which was operated by three weights totaling approximately 2 tons. That mechanism has since been replaced by an electrical system.

The foundation of the tower extends 6 feet below the surface of the ground and is 24 feet square. The bottom is composed of paving brick laid in cement without the use of sand—forming a firm footing for the base, which is 18 feet 8 inches square and has steps of Bedford limestone. The campanile is 110 feet high and is constructed of brick from Van Meter, Iowa, with decorative terra-cotta trim at the cornice and corners.

An arch base of concrete, 75 feet above the ground, supports the carillon. When the 26 bells were added, it was necessary to provide room for them and to strength-

en the tower. That was accomplished under the supervision of Dean Marston, who relied upon his memory of the old plans in designing the changes. Neither the reinforcing nor the lowering of the carillon-chamber floor by 3 feet, which permitted all the bells to hang opposite the openings, altered the outer appearance of the campanile.

A carillon is defined as "a series of bells so hung and arranged as to be capable of being played as a musical instrument by a keyboard, and must have at least two chromatically tuned octaves of bells." The word is French and stems from the medieval Latin *quadrilionem*, for the carillons of that day consisted of four bells. Now, a group of four bells is known as a chime.

The forerunner of the modern melodious bell came into being during the Bronze Age, for bronze was the first metal worked by man to produce a ringing note. After the development of "pot and bowl" bells in the Orient and by western civilizations, bells increased in number and size. In the thirteenth century, they were largely the object of study in monasteries, where music was among the cultural pursuits. Two hundred years later, when Flemish culture, especially music, was flourishing, Flanders set herself the task of perfecting the tone of bells and undoubtedly played a major role in the development of the art of bell music.

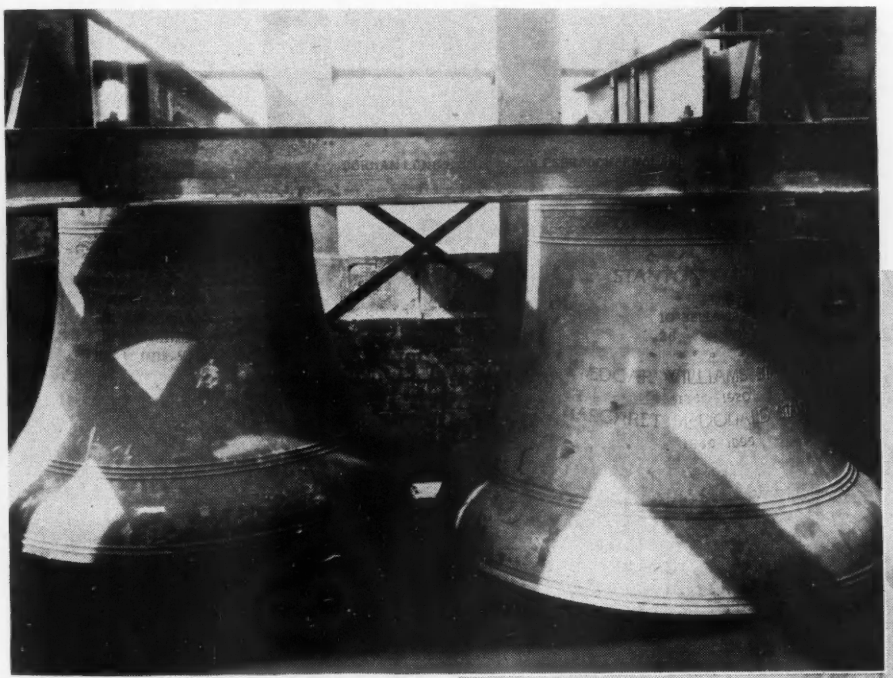
From 1630 to 1680, carillons appeared throughout the Netherlands, where the casting of fine bells was to become a family tradition. Once the perfect bell had been produced, carillons were built in the Low Countries and in England, but during all that time little if any attention was being paid to the theory of bell vibration. Apparently, the art of pouring and tuning were the highly guarded secrets of bell founders.

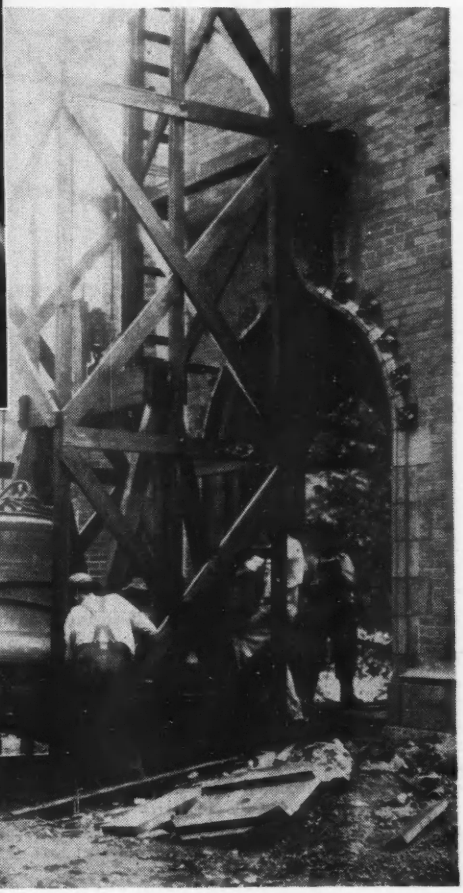
Tuning became somewhat of a lost art during the nineteenth century, which was characterized by a decline in the bell-founder's craft. However, since 1895 the principle of 5-point tuning has been developed, and bells are being cast today that surpass in quality those of the seventeenth and eighteenth centuries.

Most of the carillons in the United States and Canada have been erected since World War I. At present there are 58 in this country, principally in churches and on college campuses. The largest is in Riverside Church in New York City. It has 72 bells (the biggest weighs approximately 18 tons) and has a range of six octaves.

Even though the world's carillons are comparatively few in number, composers are continually writing special compositions for them. However, because the instruments differ so much in pitch and compass, few of the works have been published. Music written for one can rarely be played on another without special adaptation by the carillonneur. Professor Schroeder, Iowa State College carillonneur, arranges practically all his music. He has found that the carillon is not well adapted for impressionistic music because certain chords played on it develop bad overtones that would not bother a pianist.

As the full beauty of the Bells of Iowa State sing across the campus, the traditions and the history of this monumental memorial are probably best expressed by its founder, Dean Stanton: "I would have our college chimes such that they will turn the thought of student and teacher, for the moment, from daily cares to holier thinking and become a continuously enobling influence in college life."





CONSTRUCTION SCENES

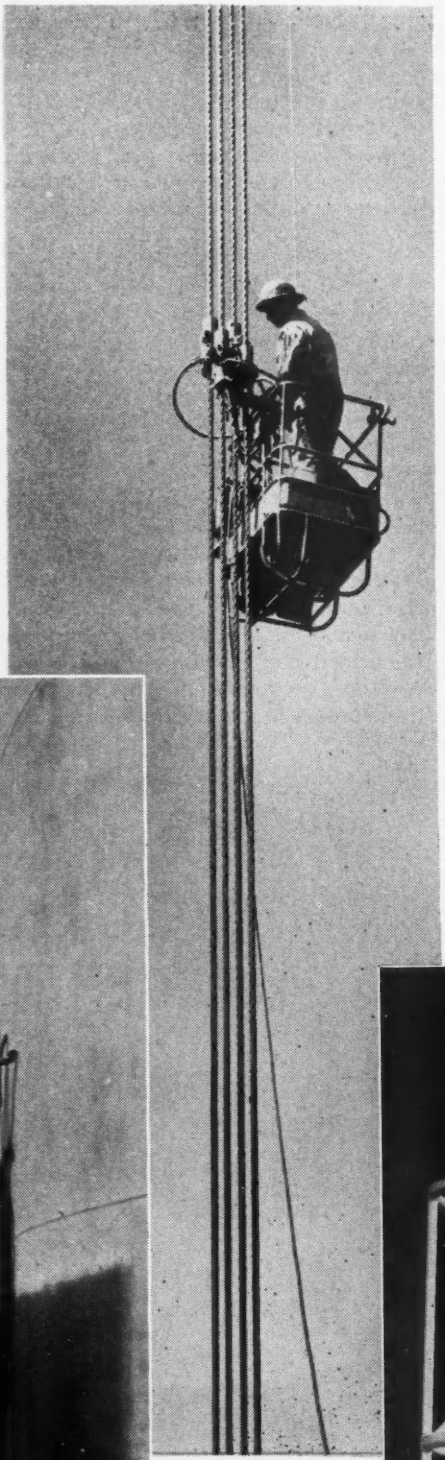
With the equipment available in 1899 it was quite a chore to hoist the ten original bells and put them in place. The view above shows two of the larger ones as they now hang, with inscriptions, decorative scrollwork and lines that were cast on them in the British foundry that made the carillon.

Lowering th os

Power-operated Worker Support Promotes Speed and Safety

RIGGING costs often make up the bulk of the expense of working high in the air. In many instances the cost of putting up scaffolding is so great as to delay or even cancel repair and maintenance work, though the jobs themselves may call for small outlays. Conditions such as these can lead to negligence that may run counter to wise conservation policies and even to safe practices. When makeshift stationary or movable rigs are resorted to for construction or maintenance purposes in high places, efficiency and safety are often difficult to attain.

These considerations brought about the trial of lightweight power-driven staging on steel-erection jobs in the Pacific Northwest in the 1930's. Their success led to the establishment of manufacturing facilities about ten years later, and the self-contained units produced, oper-



The aerial painter, right, is coating one of the quadruple vertical suspenders that hold up the deck of the Tacoma (Washington State) Narrows Bridge. The cables vary in length from 320 feet at the towers to around 10 feet at the center of the span. With the aid of the special rigging device they were passed through a continuous bath of paint and the excess was wiped off automatically. This equipment enabled workmen to paint the 1⅜-inch lines at the rate of 72 feet per minute. All told, 150,000 feet was given three coats.

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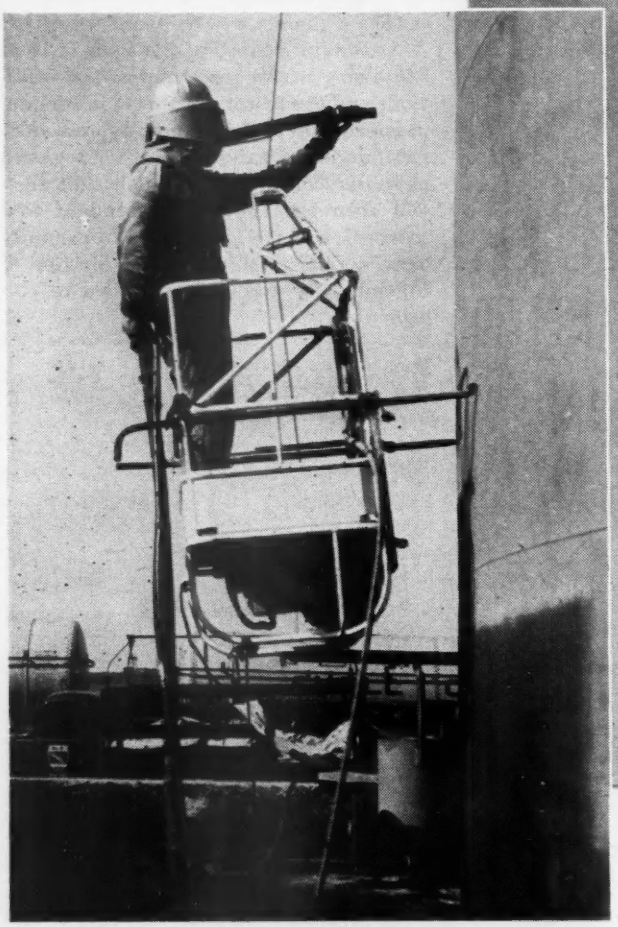
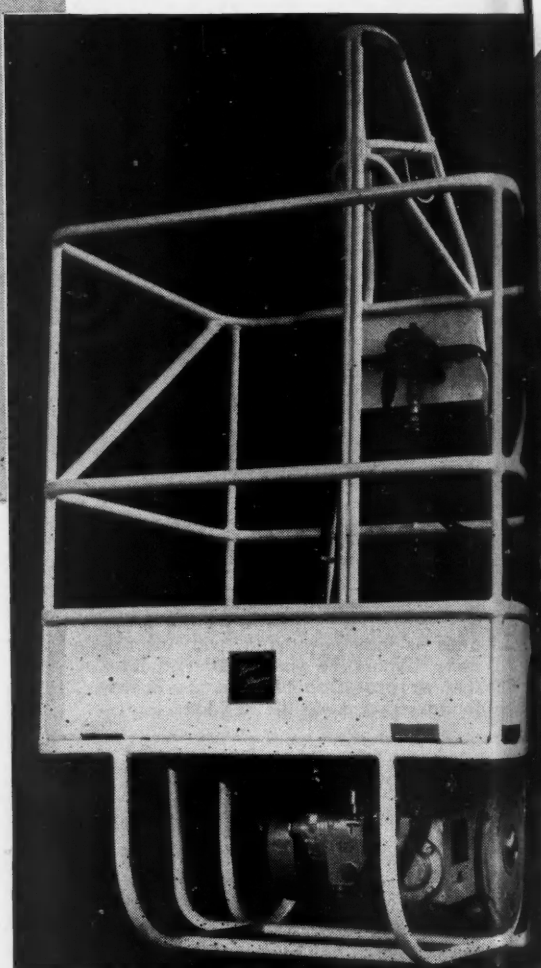
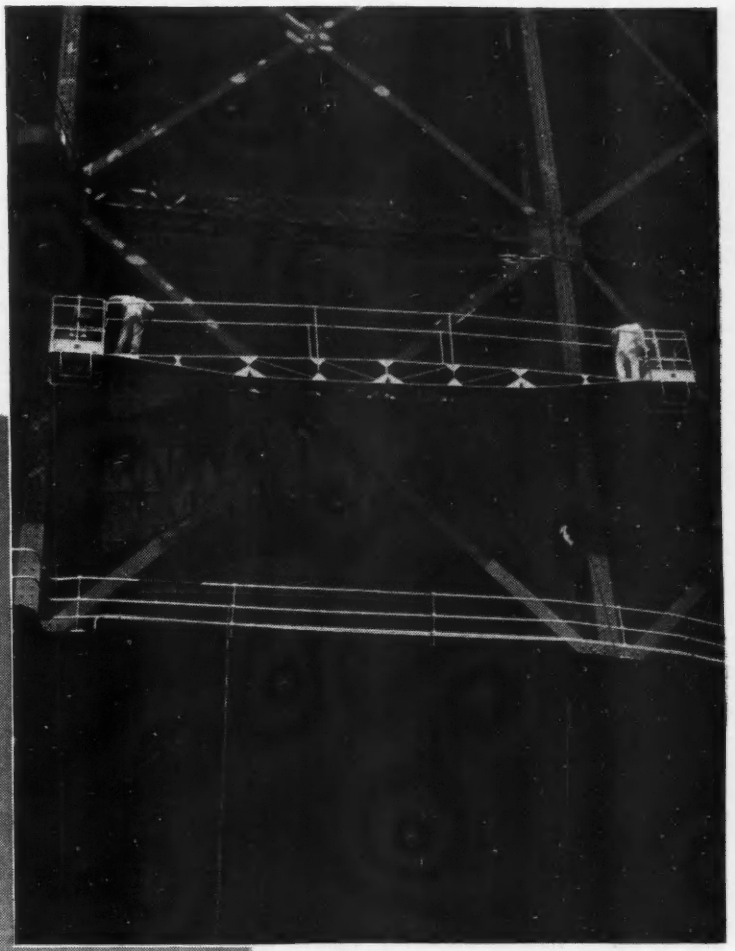
The picture below depicts the adaptability of compressed air, which was being used to power the staging motor and also to propel sand to clean the sides of a steel oil storage tank. With this modern equipment major oil companies are saving at least half the labor that was required when tanks were sandblasted and painted from old-type rigging.



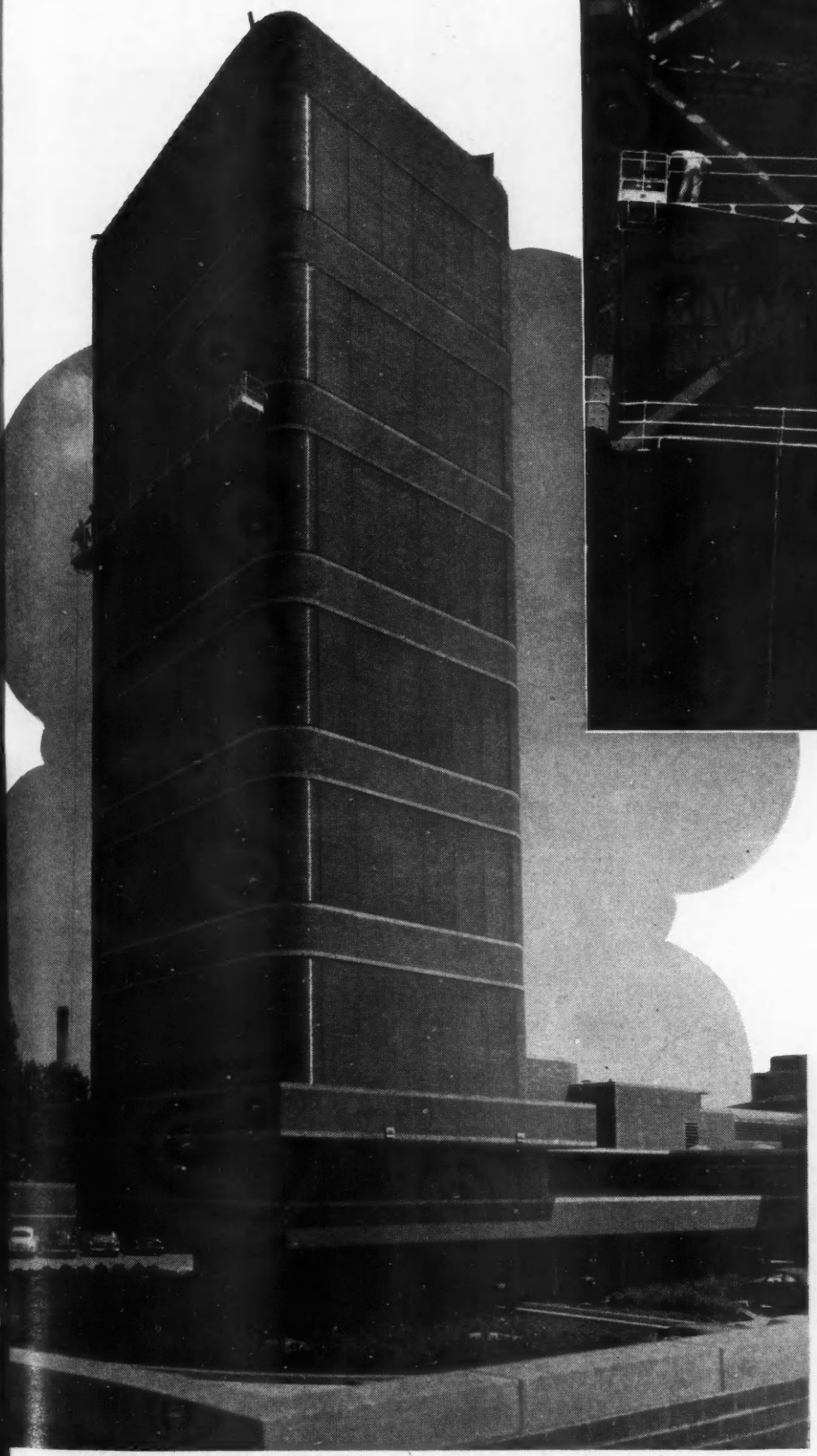


The Spider Staging shown at the right is 36 inches wide, 28 inches deep and 69 inches high, weighs 175 pounds fully equipped and can be moved up or down at a maximum speed of 24 feet per minute. Travel is controlled by the valve mounted inside the railing and power is furnished by an Ingersoll-Rand 1¼-hp Multivane air motor underneath the cage. The cable drum behind the motor holds 350 feet of 5/16-inch wire rope. Three mechanical features contribute to the safe operation of the rig: the air motor, which powers the cable drum through reduction gears, stops instantly when the air supply is cut off; a plunger-type shut-off valve on top of the motor automatically cuts off the air to the line for upward movement whenever the rope is overloaded; and an inertia-operated emergency brake built into the winch at the left of the air motor stops and holds the drum if it should accelerate above the normal rate when going downward.

th ost of High Work



Southern California Gas Company recently carried out repair and maintenance work on its many gas holders, some of which are huge steel structures as much as 350 feet high. Air-powered staging units served throughout, and were especially advantageous when pneumatic calking guns, chipping hammers, etc., had to be used, for the air supply for both the tools and the staging was obtained from a single line extending upward from the ground.



The ultramodern Johnson Wax Company laboratory building at Racine, Wis., is pictured getting a face-washing with the aid of two Spider Staging units with a connecting platform that enables the cleaning crew to go over one entire side from a single setup.

ated either by compressed-air or electric motors, are to be seen in the West on all sorts of jobs, as illustrated in these pages. Sales and distribution facilities are now being gradually extended to other parts of the nation.

It is claimed that the use of this type of equipment on any work involving rigging steps up speed and efficiency so markedly that the average cost is cut about two-thirds. By increasing safety, it has, in addition, reduced industrial-insurance rates. One maker of such scaffolding, Spider Staging, Inc., of Renton, Wash., offers, besides the standard sizes shown, a unit especially adapted for operations in tanks, towers, stacks, standpipes and grain elevators, where space is normally restricted. This compact model fits in openings as small as 34 inches in diameter and can be readily dismantled to pass through a 20-inch-diameter space.

Farm Mechanization

« Part Two »

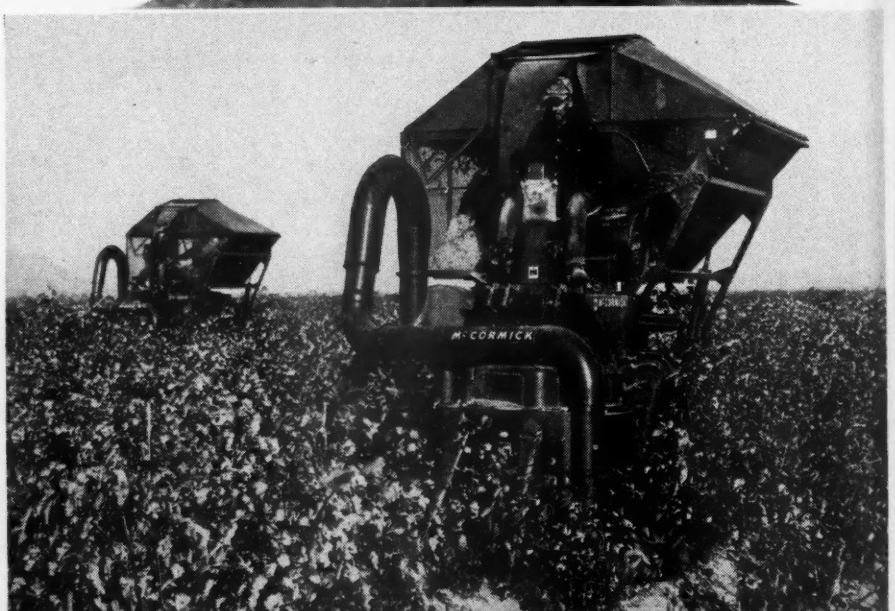
J. C. Pierce

INDOOR FARM TOOLS

More than ever before today's farmer is a businessman, and equipment such as this is now highly useful to him. Knotty problems of various kinds oblige him to work at a desk during much of the time he saves through the use of modern machinery.

IT HAS been said that a farmer's shirttail is tied to a weather vane. The inference is that he wil enjoy prosperity or suffer poverty according to the weather. His has always been a feast-or-famine livelihood, and any development that would shorten the famine periods was welcome. The coming of speedy and powerful mechanized equipment has greatly enhanced his chances of successfully tilling, planting, cultivating and harvesting his crops within a minimum of fair-weather days. Modern insecticides and medicines protect his produce and livestock from almost every imaginable pest, blight and disease. And after the harvest is in, mechanical equipment and compressed air prepare it for market or for storage.

The usefulness of air under pressure is not unknown to the farm. For centuries windmills have been utilized throughout the world to pump water and turn the wheels of gristmills. In fact, windmills are still indispensable to farms and ranches where other sources of power are not available. In some areas where the wind blows incessantly, a newer type serves as an electric generator that charges storage batteries to supply small blocks of power for various purposes. Nature's breath also has and is helping the sun to cure crops in the field and to ventilate buildings. But it is the reliable,



INTERNATIONAL HARVESTER PHOTO

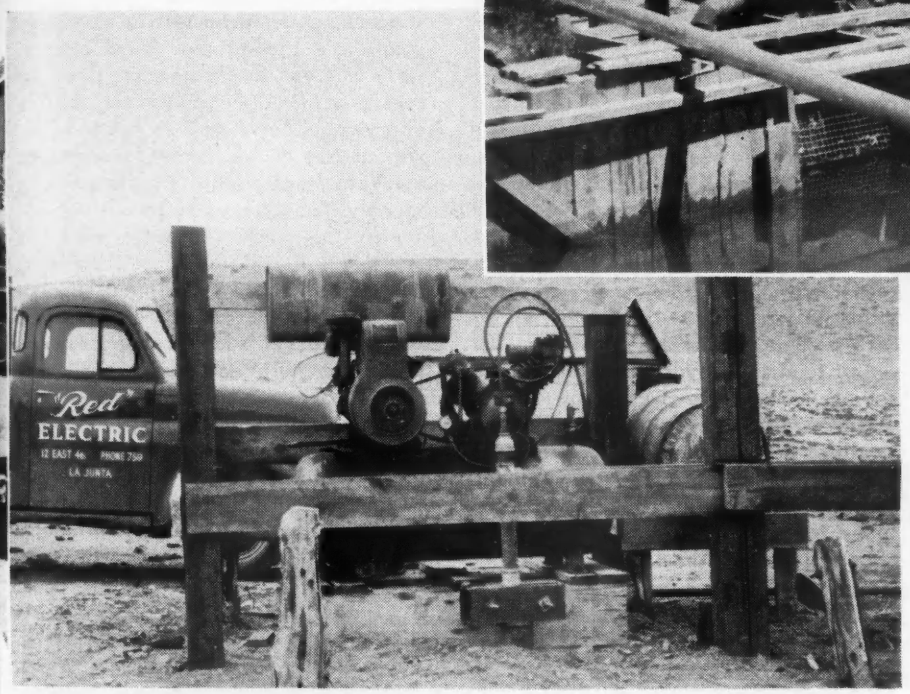
INGENIOUS MACHINES

After years of research and experimenting, a successful mechanical cotton picker was announced in 1941. Machines like those shown pick an acre in approximately 75 minutes and save from $10 to $24 a bale compared to hand picking. They often recover as much as 85 percent of the mature cotton without harming the growing plants and unopened bolls. After stripping doffers have removed the cotton from the rotating barbed spindles that have plucked it from the bolls in the picking chamber, an air stream transports it through the pipe in front of the picker into the fan housing and thence upward against cleaning grates in the roof of the large receiving basket. The same air current removes dust and small trash from the cotton on the grates before it drops into the basket proper.

AIR-BORNE FORAGE

Getting ensilage into a silo is simple with the equipment shown at the left. A variable-speed, raddle-type conveyor feeds it into the curved blades of a blower, where it is thrown into an air stream that carries it to the top of the silo. Such forage blowers, like most farm equipment, are generally run by power take-off from a tractor, but are sometimes driven by internal-combustion engines or electric motors.

ALLIS-CHALMERS PHOTO



PUMPING IN ARID SECTIONS

Sufficient water, properly applied, transforms barren deserts into productive agricultural lands. Large cultivated tracts are irrigated with water carried in ditches from man-made lakes that impound runoff, or from wells equipped with pumps. Years of pumping coupled with subnormal precipitation have lowered groundwater levels in many areas. More wells have been drilled, existing ones deepened, higher-capacity pumps installed and conservation programs put into effect. One such measure calls for spraying crops—simulating rainfall—with the required amount of water at specified times. Shown at the top are two Ingersoll-Rand pumps that deliver water at high pressure from an irrigation ditch to networks of spray-nozzled pipe lines. On one farm a similar pump, mounted on a tractor and driven by power take-off, is moved between several irrigating systems, thus serving a large acreage. The air-lift pumping method is sometimes applied to deep wells where the normal water level may vary considerably and where delivery capacities can change appreciably and on short notice. Such conditions are found on the R. P. Lewis & Son ranch near La Junta, Colo., and met by the installation shown directly above. Furnishing air for the lift is an Ingersoll-Rand 5-hp, 2-stage compressor. About 10 gpm is raised 450 feet from a well that has a static water level of 276 feet. The flow is discharged into a circular stock-watering tank near the well.

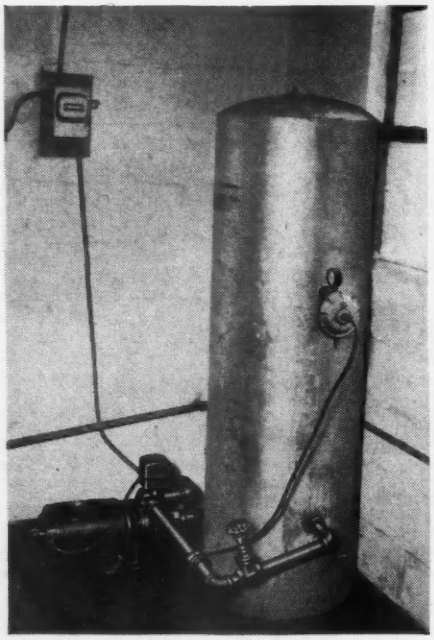
push-button controlled air from compressors and fans that has given the farmer an added means of lightening his work. This highly adaptable farmhand is demonstrating to agriculturists everywhere that it will serve them in nearly every branch of their activities.

Compressed air can be an important factor in clearing and leveling virgin lands for tilling, which often requires the use of brush-burning apparatus and drills for blast holes. In districts where irrigation is practiced it is of aid not only in constructing dams and digging ditches that store and carry the life-giving water but also in well-drilling and pumping operations. Structural and major repair work on farms can be done expeditiously with the help of pneumatic tools. Today, one of the popular labor-saving devices in dairy barns is a mechanical conveyor that carries manure out to a spreader or stockpile. It runs in a depression in the concrete floor immediately back of the stalls and its installation often necessitates breaking out old concrete—a job for a pneumatic paving breaker whether considered from a labor- or a money-saving standpoint.

Wheels for modern field equipment and haulage trucks, like those for highway transport, run on air cushions, and with a national average of 52 tires per farm the agriculturist is the rubber industry's biggest tire customer. According to the 1950 census there were an estimated 2,209,000 pneumatic-tired motor trucks, 3,619,000 tractors and 4,208,000 automobiles on farms in the United States. And tires are standard equipment on the newer models of 2,707,000 moldboard plows, 1,446,000 manure spreaders, 714,000 combines, 886,200 grain binders, 456,000 corn pickers and similar mobile units now in use.

Some farms boast a small air compressor exclusively for tire inflation. It may be a gas-engine machine that can be pulled or carried to the vehicles that require servicing, or an electric-driven unit stationed in the farm shop and charging a conveniently sized receiver which is transported to the point of application. In addition, compressors suitable for inflating tires and operating lubricators are now mounted on tractors and driven by belt from the power take-off. Just as the hand tire pump is rapidly becoming outmoded so is the manually pressured oil or grease gun disappearing. The multiplicity of moving machinery parts call for speedy and positive methods of lubrication.

More mechanical equipment means more maintenance and repair, and many farms have machine shops where much of that work, along with some construction, can be done efficiently by pneumatic and electric tools. There is a trend towards compressors of sufficient capacity to power drills, saws, nut runners, hoists and other shop facilities—compressors that can also operate hand-held implements such as shovels, hoes, shears, picks and saws, as well as silage-removal



PIPED WATER

An automatic water pressure system such as the Ingersoll-Rand Supirjet eliminates carrying water around the farm, for it can be piped to stables, barns, pigpens and poultry yards. It also lightens the farmwife's burden by bringing running water into the house.

equipment, feed grinders, limestone pulverizers, paint and insecticide sprays, cleaning and other miscellaneous apparatus.

Preparing land for sowing may call for a number of special implements depending upon the character of the soil and the crops to be planted. Among these tilling devices are plows and field cultivators of a great variety, harrows, soil pulverizers, packers, floats, drags and stock cutters. On large-acreage farms, like the great wheat spreads of Montana, Kansas and Texas and the barley fields of California, they often attain considerable bulk and may require pneumatic or hydraulic control and operating accessories. For example, there is a 6-foot moldboard plow pulled by three crawlers that turns up the soil to a depth of 5 feet. Compressed air is used to raise the bottom of this giant and to flip it over for reverse-direction plowing. Where multiple-unit equipment is utilized, air under pressure may be the invisible operator of one or more of the units.

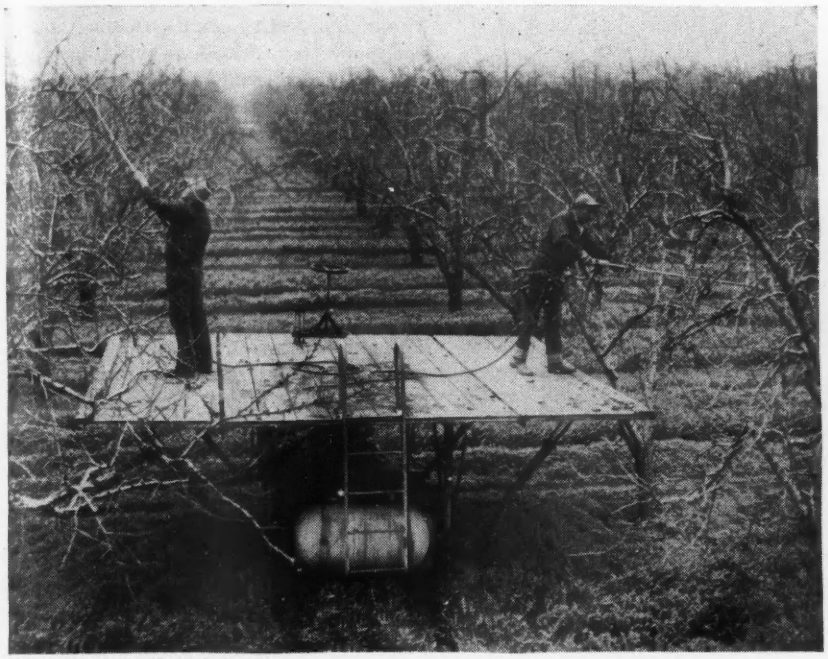
With the soil properly prepared to receive the seed or young plants, another group of mechanical marvels is brought into action. Classified according to the crop as grain drills, row crop planters, broadcasters and transplanters, they are designed to perform in a single pass all the work that will insure prompt and uniform germination and growth. Recent models, which likewise distribute prepared fertilizers with or adjacent to each seed or plant, are provided with compressed air or hydraulic systems that actuate parts of the mechanisms.

Every soil and every crop in different localities have to be cultivated individually. This has led to the development of highly specialized tractor-drawn, multiple-row cultivators, some of the larger of which depend on air and hydraulic power for control and other purposes. These machines are rapidly replacing horse-drawn single-row units. Pneumatic tools also have been designed to relieve men of much of the arduous, back-breaking job of loosening the soil. One California grower of sugar beets has devised a mobile rack carrying a compressor and with room for six men to lie prone. Each has a pneumatic hoe, and as the rack is pulled over the fields by tractor the workers cultivate the ground quickly and with a minimum of fatigue. Compressed air furnishes the necessary oxygen and pressure for flame cultivators available in single-unit hand or multiple-unit mobile models for burning young weeds between crop rows.

Speed and efficiency are of paramount importance especially at ingathering time, and harvesting equipment is chosen with these requirements in view. If it's a hay crop, the machines that mow, rake, load, stack or bale must make quick work of it. If it's small grain, combines will get it into storage or ready for market with ease and speed undreamed of even twenty years ago. Blasts of air, created during the operating cycle, remove chaff and straw as the jaws gobble up the crop. Picking and husking corn by hand used to be a slow and tedious job, but now a single machine will cover twelve acres or more

LIGHTENING THE FARMER'S LABOR

How many strokes with a hand pump will the air compressor in the left-hand corner, above, save? How many hours of travel to and from the nearest service station will it save the New Jersey farmer-owner this year? The same Ingersoll-Rand compressor can also save him hours of work in other directions: painting, lubricating machinery, or running shop tools such as the air-operated impact wrench, left, which is being used to run down nuts on $^{7}/_{16}$-inch bolts on the straw rack of a Clifford grain combine. In 1944, more than 100 years after the substitution of animal and machine power for hand labor had begun, the U. S. Department of Agriculture found that about 60 percent of the 21.2 billion man-hours of farmwork was done by hand or with small hand-held tools. The combination of a continually dwindling labor supply and a demand for greater productivity emphasizes the growing need for powered hand tools.



AMERICAN FRUIT GROWER PHOTO

ORCHARD ORDERLY

Power pruning is saving orchardists an estimated $25,000,000 annually in California alone. Scores of men on ladders have given way to a few on compressor-equipped rigs of variable sizes and shapes that are factory-built or farmshop made and horse-, truck- or tractor-drawn or self-propelled. A 2-row contrivance is shown at the left in an apricot orchard. With it and with extended-arm pneumatic shears the pruning job is a comparatively easy one and goes fast. Pneumatic saws take care of the larger branches. For higher reaches, towers on telescoping arms powered by pneumatic or hydraulic means lift the operators even to the topmost fruit on the tallest date palms. Other work such as thinning, harvesting and artificial pollination is also carried out from platforms like this. The men pictured at the right are thinning an apple orchard in Oregon. With machines of this kind four men can cover a 30-acre orchard in twelve days compared to twenty required by ten men on ladders. Or they can pick 30 acres of apples in seventeen days, replacing twelve men on ladders. Besides, taking men off ladders increases safety.

a day. A new model not only picks and husks but also shells the corn while strong currents of blower air carry away small stones, stalks, loose husks and other debris, thus delivering a ready-to-use product in the field and cleaned cobs for discard.

The last word in forage-crop harvesters is a model that handles any kind—row crop such as corn or maize, a direct-cut grass or legume crop or a windrowed crop. It cuts, gathers, chops and discharges the forage in a single pass at a fast rate, loading into field pickup vehicles usually being effected by the throwing action of the fast-turning cupped knives of the chopping cylinder and the air blast induced by the revolving blades.

To offset the dwindling labor supply, harvesting machines have been designed to meet the needs of nearly every crop grown on a large scale. There are beet lifters, toppers and harvesters, bean pickers and potato diggers. The question as to just how far the development of harvesting equipment will go offers food for speculation. Now a ponderous experimental machine, operated by one man, unloads a ton of delicate ready-to-cook peas after it has been pulled over an acre of pea vines for an hour. It releases the peas from the pods by rubbing and pressing the latter against corrugated plates, and is reported to be doing satisfactory work.

One of the more ingenious of the harvesters is the cotton picker. This curious-looking monster, built in single- and double-row models, is almost human in the way it gathers the crop. Leading implement manufacturers experimented for years before they developed a satisfactory type. Some of the early machines plucked the ripe cotton from the bolls by suction, but revolving spindles have proved to be more effective. Fundamentally, the process is as follows:

The self-propelled harvester, traveling down the rows, guides the plants into the picking unit where scores of turning barbed or grooved spindles come in contact with the open bolls and pull out the cotton, which is then removed from the revolving spindles in a stripper section. From there it is conveyed by air from a blower through an elevator chute out into a receiver, whence it is unloaded by power means. The air current also serves to rid the cotton of dirt and other small foreign particles as it is discharged into the container. These mechanical pickers are in short supply on the labor-scarce cotton fields. California borrowed 1100 last year to augment its own fleet of 2500 to harvest an unusually large yield. In Texas only about 20 percent of the more than six-million-bale crop was picked mechanically in 1951, and a large percentage of that was taken by strippers which merely yank the entire boll from the plant.

In preparing harvested crops for market or for storage, air at varying pressures plays other important roles. It will be found performing such jobs as conveying, cleaning and drying in connection with ensilage and forage choppers, feed grinders, corn shellers, fanning and cleaning mills, fruit graders and sorters, crop driers, etc. The latter equipment takes over at harvest time when winds and sunshine are not available, or haven't finished their curing task, or when a crop is rained on. Essentially a blower, it forces dry and often heated air through wet- or early-harvested crops to extract excess moisture that promotes mold, causes spontaneous combustion, takes up valuable storage space or is otherwise deleterious. Among the earliest applications was that of drying corn so that it could be stored in the crib without danger of spoilage.

The U. S. Department of Agriculture reports that hay barn-dried with heated air tends to produce 116 percent as much milk as good field-cured hay and 145 percent as much as field-cured hay on which rain has fallen. Now driers are being used on root as well as forage crops and corn, and it is estimated that 10,000 will be sold in the 1951-55 period to add to the 5100 that were already on farms at the end of 1950. It is an adaptable piece of equipment, for it can be easily moved to dry not only crops but also buildings and to heat them.

We have seen that many implements

BALANCED AIR

The seed of soil-building Ladino clover is small, light, and fragile and much of it drops to the ground during harvesting. This presented a serious problem until a California farmer applied the principle of his wife's vacuum cleaner to the job. The first "sucker-upper," as local farmers call it, was made from a reversed blower and led to harvesters like the one shown. Windrowed clover is drawn into the combine by vacuum, threshed in a rotary fan, and the seed and straw are separated by carefully balanced currents of air under pressure and vacuum. Substantial additional recoveries of the valuable seed are made by going back over the stubble with the combine and by rethreshing the straw residue from the first harvesting operation. Other tiny and easily shattered seeds such as dichondra lawn seed are gathered by vacuum. The principle has also been applied to harvesting cranberries, the fruit being sucked from the bushes through a rubber tube and discharged into a rubber-cushioned container. Almonds shaken from trees by the blows of rubber mallets are likewise picked off the ground by a vacuum attachment on a harvesting machine, conveyed to the rear of the unit, rid of dirt and trash by air blasts and bagged for marketing.

use air to clean and convey crops as they harvest them. Now let us look at air conveyors and elevators as separate units working in place of less-efficient mechanical devices to save millions of man-hours each year. Whether forage crops are put into a silo wet or dry, whole or ground, they are usually elevated by a strong current of air from a forage blower fed either by hand or by a conveyor system and driven by a transmission belt from the tractor power take-off or by a suitable electric motor or internal-combustion engine.

The material handled determines the size and speed of the blower. For example, a 30-inch fan running at 750 rpm, or a 48-inch unit operating at lower speed, will put corn silage into a 60-foot silo, while from 10 to 25 percent greater blower capacity is needed to store grass silage. Blowers are incorporated in feed grinders and choppers, and provide the air for loading and unloading the smaller-sized products on the farm. Recent experiments indicate that grain can be conveyed through 1-inch piping with bends and varying angles by a controlled current of compressed air. It was found that 14 cfm of air at 5 psi can move a ton of wheat about 100 feet an hour.

Spraying and dusting is important business on most farms and ranches and the largest single operation performed by fruit growers. Great quantities of scientifically prepared chemical and medicinal compounds are applied each year in the form of mist, spray or dust to keep the enemies of crops and livestock under control. Applied by air pressure or pumps or disseminated by airplane, these man-made agencies destroy the insects, diseases, blights and weeds that can turn profit into loss overnight. Applicators range in size from the smallest hand garden or poultry gun to powerful spray and dust dispensers that can cover many acres under cultivation, hundreds of animals and many buildings in a day.

The chemical control of weeds is a vital factor in agriculture and has contributed much to cotton growing. One of the planter's big expense items is that of hoeing his crop to keep out weeds — and cotton-choppers at any pay rate are now scarce. Solutions that kill weeds but don't harm the plants have come to the rescue. Some are applied to the soil at the time of planting to destroy weeds in the seed, and others are sprayed over the fields to kill them after they emerge. This chemical method, as compared with hand weeding, is reported to be cutting the cost of cultivating cotton fields to about one-fourth, and because of its economic advantages is winning favor in farming generally and wherever it is necessary to cope with weeds on a large scale.

The care and handling of livestock and their products have likewise reached a highly mechanized plane. For many jobs that formerly took much of a farmhand's time—feeding, watering, doctoring and cleaning up, for instance—he now has mechanical assistants or substitutes. The milking machine with its vacuum pump is now standard equipment even on small dairy farms. The ever-increasing refrigeration units for the storage of milk and other perishables constitute a large market for compressors. Even operating the cream separator, the churn and the ice-cream freezer has been largely eliminated from the list of hand chores. Incubators, brooders, automatic feeders and lighting systems, egg cleaners and scores of other devices have not only made poultry raising easier but have also padded the farmer's purse because of higher and better production.

In spite of the growth in farm mechanization it is far from complete. Less than half of the nation's farms have tractors, only about one-third have motor trucks and approximately 16 percent are not yet electrified. Since farmers use machinery to save manpower and to lighten their work, and since they are faced with the problem of greater productivity with even less help than they now have, there is no choice left them but to mechanize wherever possible.

TEXAS COMPANY PHOTO

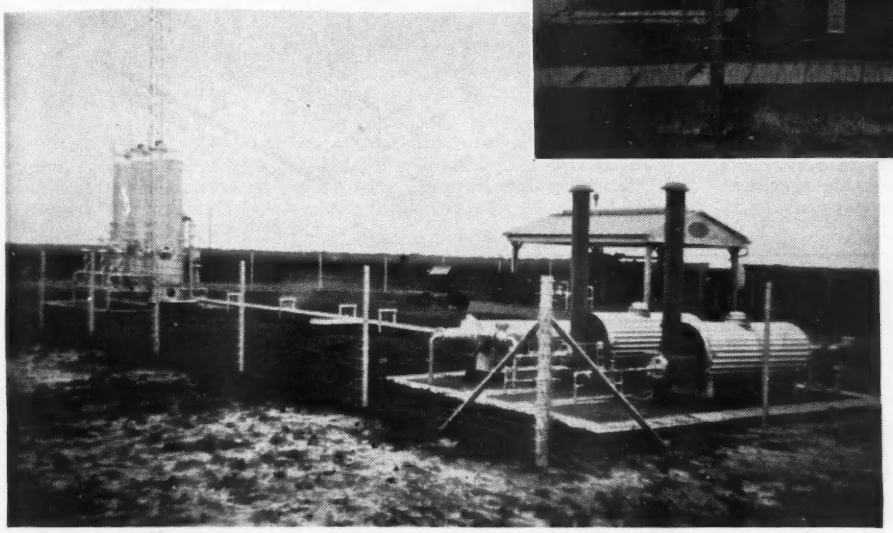
DEWATERING DEVICE

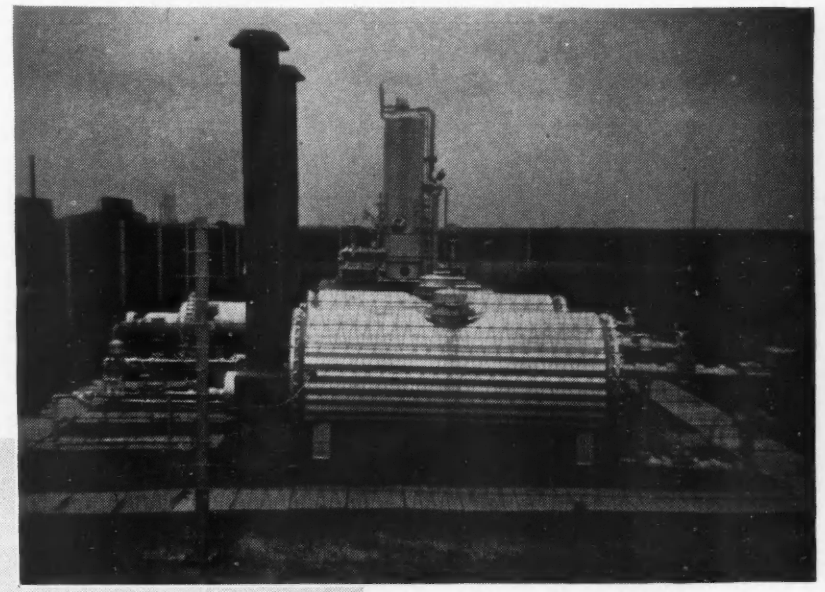
If man can make rain fall, possibly he will also find a way to hold back unwanted precipitation. Meanwhile, an Oregon cherry grower, W. H. Meyer, has rigged up this apparatus which runs between the rows of trees and blows water off the fruit immediately after a rain and before it can cause cracking and splitting. In a few hours this $200 rig can avert a $5000 loss in Meyer's 100-acre orchard.

New Life for an Old Oil Sand

Novel Practice in Texas Field Produces Dual Benefit

H. F. Smith





PLANT VIEWS

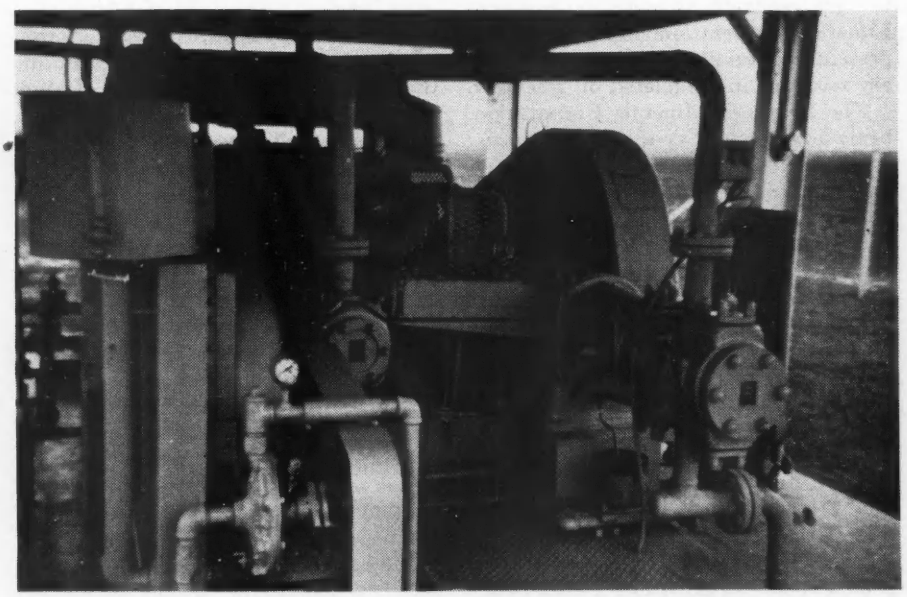
In the foreground of the picture at the left are two heaters (with stacks) and a heat exchanger. Back of them and under cover are the compressors. The separators are at the left. The view above was taken from a different angle.

TWO long-standing problems in the oil and gas business are being solved by engineers of the Southern Minerals Corporation of Corpus Christi, Tex., by the use of an unusual method at what is known as the firm's Sellers Lease. In short, they are obtaining crude oil from a reservoir that was considered to be depleted, accomplishing this by injecting liquefied petroleum gas (LPG) into the formation and thereby reducing the viscosity of the oil still in the ground as well as increasing the bottom-hole pressure. Also, they are storing the LPG in the underground reservoir, for it would otherwise be injected into gas-transmission lines because it is produced during the summer months when the market for it is poor and no above-ground storage is available.

A task that confronts oilmen is how to raise crude remaining in the ground after well pressures decline and the oil tends to cling to the sand in which it is enclosed. Another difficulty is the storage of liquefied petroleum gas, which is known to most people as "bottled gas" used for fuel in many rural homes. LPG is made up of hydrocarbons composed mainly of propane and butane, which are produced in numerous plants throughout Texas and elsewhere in the Southwest.

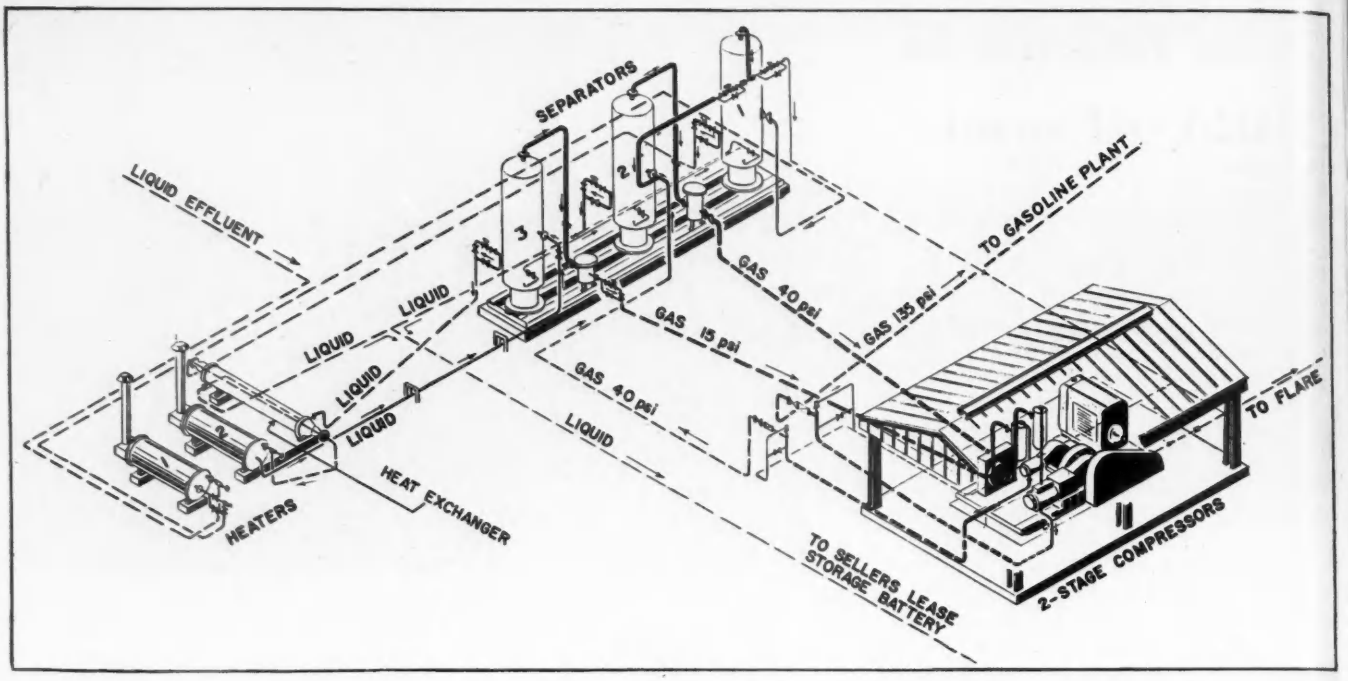
The demand for LPG varies directly with the season, and whenever the market is poor the storage problem becomes acute very rapidly. The cost of above-ground pressure storage tanks is approximately $10 per barrel of capacity, and it is economical to provide only a certain number at each plant. For years, the producer, distributor and consumer have individually tried to persuade the others to increase their storage capacity, and the industry has finally recognized the problem and is taking steps to minimize it. At the present time, however, the storage available is generally sufficient for only five days' output from the various plants.

M. H. Kotzebue, president of Gasoline Plant Construction Corporation, Houston, Tex., first patented an idea in 1938 for producing hydrocarbons from sands by recirculating a light oil in the formation. The method consisted in pumping a light mineral oil down the well through



COMPRESSORS

The two single-stage, straight-line Ingersoll-Rand units are driven by a single Waukesha gas engine. Compressors, driver and all auxiliary equipment are mounted on a skid as a packaged unit fabricated by Wilson Supply Company.



PERSPECTIVE SKETCH

Despite the numerous operations involved, as indicated by the flow lines of gas and liquid, not a great deal of equipment is required and it is all on a rather small plot enclosed by a wire fence and with unoccupied areas planted in grass. Because the climate is mild, nothing is completely housed, although there is a roof over the compressors.

the central tubing and bringing it, along with the absorbed and entrained hydrocarbons, back up through the annular space between the tubing and the well casing. Mr. Kotzebue, who by the way was the recipient of the Natural Gasoline Association's coveted Hanlon Award in 1943, also conceived the idea of injecting LPG, as well as the gas produced in a virgin oil sand, back into the formation to reduce the viscosity of the crude, to cut the oil loose from the enclosing reservoir rock and to help maintain reservoir pressure. This method is similar to the one now being practiced by the Southern Minerals Corporation, except that the present one serves as a means of secondary recovery in a depleted oil reservoir.

The Southern Minerals Corporation, being an oil as well as an LPG producer, was confronted with both problems and made plans to apply Mr. Kotzebue's ideas. A depleted oil sand adjacent to one of its plants that turns out LPG is isolated by reason of the fact that it is a completely enclosed lense surrounded by structural faults. Therefore, it is an ideal location for LPG storage. Only two wells penetrate this sand. One of them is now being used for the injection of hydrocarbons and the other for production or recovery.

In addition to storing the LPG, Southern Minerals wanted to recover the crude oil that could not be produced by conventional means. The operations were placed under the direction of Vice-President F. P. Peterson, Jr., and the following arrangement was decided on. Close to the recovery well were installed two Ingersoll-Rand Class ES-1 compressors: a 5½x9-inch unit and the other a 5x4 machine. They are driven by a single Waukesha 140 GKU gas engine, their flywheels being coupled so that both operate at 325 rpm. Wilson Supply Company of Houston fabricated the packaged unit, which consists of the compressors, engine, compressor-jacket water cooler and pump, and a gas scrubber for each compressor, all mounted on a skid.

The 5½x9-inch machine compresses all the LPG gas that goes through the station, whereas the 5x4-inch unit compresses only the gases that are flashed in one of the separators. In addition to the equipment mentioned, the recovery unit has two heaters, one heat exchanger and three separators, the functions of all of which will be outlined.

The liquid effluent from the well flows, first to No. 1 Heater, where it is brought to a temperature of about 110°F, and from there to Separator No. 1. In this vessel the gas is separated from the liquid and flashed off the top and then directed to Separator No. 2, where it is mixed with gas coming from the discharge of the 5x4-inch compressor. From Separator No. 2 the gas passes through a filter to the 5½x9-inch machine, which compresses it from 40 to 135 psi, gauge pressure. After being liquefied by cooling, it is piped to the deëthanizer feed tank in the nearby Southern Minerals gasoline plant.

Now to return to Separator No. 1 to trace the liquid flow. From the bottom of this unit the liquid enters the heat exchanger where some heat is picked up; passes through Heater No. 2, where more heat is added; and next goes to Separator No. 3. There the liquid is flashed again, and the light ends, in the form of gas, are taken off the top and piped through a filter to the 5x4-inch compressor. This gas is compressed from 15 to 40 psi and flows into Separator No. 2, where it is mixed with gas coming in from Separator No. 1, as previously explained. Any liquid from Separator No. 2 is dumped directly into the Lease storage battery. Liquid from the bottom of Separator No. 3 is piped through the heat exchanger and then to the same storage.

At the present time no conclusion can be drawn as to the ultimate success of this operation, but through March of this year a total of 1,305,000 gallons of LPG has been recovered. True, 3,850,000 gallons has been injected into the sand, but this has been going on for some time—was started months before the compressor station was installed. Furthermore, 24 barrels of crude oil has been produced daily, whereas the reservoir was completely depleted before the storage of LPG began. It is interesting to note that the composition of the injected and reclaimed LPG is the same: 35 percent butane and 65 percent propane.

In viewing the over-all picture, it should be remembered that the crude oil could never have been recovered but for this relatively simple method of using LPG as an agent to lower the viscosity of the oil and to increase well pressure. Also, the LPG stored in the reservoir would have been wasted because no overground storage was available at the time it was produced.

Shown here is one of the driving units. An air motor drives a shaft on which are gear wheels whose teeth engage the links in continuous chains on both sides of the conveyor. The shaft is reversible, and controls are arranged so that all motors can be stopped from different points along the conveyor.

To dump its load, the conveyor is turned completely over, or it can be tipped to any angle desired. This latter feature is advantageous at times because varying degrees of tilt permit the discharge of materials of different sizes. Hence, it is possible to accomplish some segregation of coal.

New Mine Conveyor Performs Many Antics

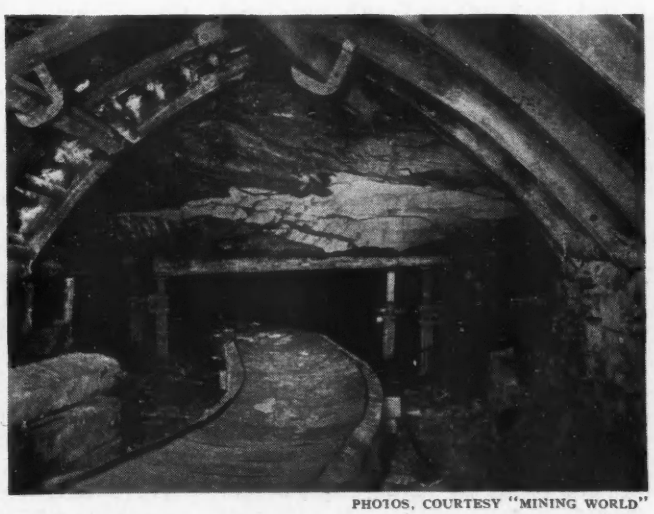
No small amount of interest is being shown in the Hemscheidt conveyor pictured on this page. It can carry material in two directions simultaneously, turn corners in opposing directions, will operate upside down, on edge, or at any angle between — and do all this while going up and down slopes pitching as much as 30° from the horizontal.

The transportation system is made up of concave troughs and can be driven by compressed air or electric motors from either or both sides at the same time through the medium of link chains attached to the outer edges of the troughs by special eyes. It travels on a metal framework and runs on ball bearings set in channel-shaped iron rail guides. The bearings, of which there are 3600 every 100 meters (328 feet), are of a special type designed to function in dust-laden atmospheres. They are lubricated under pressure by a stationary dispenser that applies a fine spray of oil which also helps to clean them. Crushed coke, ashes, iron filings and other highly abrasive materials have been introduced to the bearings without harming them. As a matter of fact they rejected these substances because of their tendency to clean themselves.

Because it can operate in opposing directions simultaneously, such a system can carry supplies into a mine while coal or ore is being brought out. Cleaning of the trough can be accomplished quickly by turning it upside down. The loading width is normally 600 millimeters (23½ inches), but for use in narrow passageways there is one 400 millimeters (15¾ inches) wide. As a means of further conserving space, the return section of the conveyor can be upended at right angles to the carrying member surface if desired.

The installation is a 2132-foot-long test system in the Friedrich der Grosse coal mine in Germany. Four 20-hp motors operated by air at 60-75 psi pressure serve to drive it over the trial course. The management considers the conveyor entirely satisfactory after a 5-month uninterrupted test period, according to an article in the March, 1952, issue of the *Mining World*.

The outbound loaded conveyor emerges from the left drift while the inbound line branches into the drift from the right. This 600-millimeter-wide (about 2 feet) conveyor running at a speed of one meter per second will carry 150-180 tons of coal hourly.



PHOTOS, COURTESY "MINING WORLD"

The troughed segments are visible in this view of an unloaded conveyor. Strips of rubber under and between the segments bridge the spaces in order to retain the finer sizes of material carried. Here metal guards cover the drive chains on both sides.

CHEMICALS REPLACE FIRE

FOR probably 5000 years man has, as recounted by the monk Theophilus, first writer on metallurgy, "black'd his fingers and sing'd his beard in metallick operations." During all that period fire has been one of the principal tools in ore reduction. From the blast furnace we get iron, and all the other metals we get chiefly from smelters. By combining mechanical and chemical processes, ores can be concentrated, but when it comes to breaking the bond between metal and its matrix, we have always resorted primarily to fire.

Now there is the possibility that the reign of fire is over; that chemistry is to supplant it. At least, that is the far-reaching implication to be derived from an announcement by Chemical Construction Corporation, a subsidiary of American Cyanamid Company and known in the industry as Chemico. The story of the new development records another triumph for industrial research. And, as often happens, the investigations were carried on concurrently by two organizations, both of which must be given a share of the credit for the accomplishments. In this instance the second concern is Sherritt Gordon Mines Ltd., whose budding operations at Lynn Lake, in northern Manitoba, Canada, were the subject of an article in our March issue.

The chemical process will, it is reported, vary in detail with each commercial application, and determination of the most suitable one will require additional pilot-scale experimentation. Already, however, a method of treating the nickel-copper-cobalt ore from Lynn Lake has reached the working stage, and Sherritt Gordon is getting ready to build a $17,000,000 plant at Fort Saskatchewan, Alberta, a location chosen primarily because natural gas is nearby. Even before that plant is running, Howe Sound Mining Company will be treating daily 35 tons of cobalt concentrate from its Blackbird Mine near Cobalt, Idaho. This operation at Salt Lake City, Utah, is expected to yield annually 2000 tons of pure cobalt, which is equal to one-half the metal the nation consumed in 1950.

Another plant to use the process will be a $5,000,000 refinery being constructed at Fredericktown, Mo., for National Lead Company. It will handle 50 tons of concentrate daily and produce yearly 700 tons each of cobalt and copper, 900 tons of nickel and 7500 tons of fertilizer-grade ammonium sulphate. In addition to treating concentrates, the method can be adapted for the recovery of pure copper powder from any form of copper scrap, blister copper, or brass.

The procedure will, it is claimed, cut costs so greatly that the resultant saving will in some instances defray the cost of scrapping existing smelting and refining methods in about three years. It will also reduce the time of producing metal from ore to a matter of hours, as compared to the several months that now elapse in some cases.

American Cyanamid's interest in the matter originated in 1934, when Edward S. Roberts, now vice-president and chief engineer of Chemico, made a chance discovery that gave clues to a method of producing ammonia at low cost. This prompted investigators to look for possible uses of low-cost ammonia, and among those brought to light was one for leaching copper ore. Thus was launched a broad-scale research program in the field of metallurgical processes that led, first, to the new technique as regards copper and then to the treatment of nickel and cobalt concentrates.

Meanwhile, Sherritt Gordon's president, Eldon L. Brown, was seeking a way to reduce Lynn Lake's sulphide ore without the roasters, blast furnaces, converters and electrolytic refinery that are customarily built for producing nickel. In seeking a different process he was encouraged by the fact that a satisfactory method of leaching the nickel ore from the Nicara Mine in Cuba had been devised during World War II. That was an oxide ore, however, and differed much from the sulphide at Lynn Lake.

In 1946, Eldon Brown turned the matter over to Prof. Frank Forward of the University of British Columbia, a school that had previously solved some knotty metallurgical problems. Professor Forward came up with an answer in 1948. His process called for leaching the finely ground nickel-copper-cobalt concentrate with strong aqua-ammonia and oxygen and recovering the nickel in the form of an oxide.

In December, 1948, Sherritt Gordon submitted the findings to Chemico for an expert opinion, and the latter's engineers found that some of their techniques could be combined with those of Professor Forward to obtain nickel metal as the end product instead of oxide. This contact between the two companies led to a continuing close relationship, with the result that the best features of the two processes have been combined. Sherritt Gordon will share in the royalties whenever the use of the method involves phases that it helped to develop.

At Lynn Lake, Sherritt Gordon will make a partial separation of copper and nickel ores by flotation milling. The copper concentrate will go to a smelter at nearby Flin Flon for treatment and the nickel concentrate will be shipped to the new refinery at Fort Saskatchewan. The latter material will contain some copper, and it, too, will be recovered.

Reaching the refinery in finely divided form, the concentrate will be put under 100 psi air pressure in a sealed autoclave and agitated while being treated with a strong solution of ammonia and oxygen. The mixture will generate its own heat, which will be held at about 170°F by circulating cooling water around the vessel. The residue from the first autoclave will be passed to a second one, where the treatment will be repeated. The leach liquor from No. 2 will be returned to No. 1 and then drawn off the latter for recovery of the metals. The residue from No. 2 will be discarded.

In the autoclaves the metallic sulphides will be converted to metal amines and carried in solution. The leach liquor will be separately treated for precipitation of the copper, nickel and cobalt, in that order. Left in the liquor will be the iron and sulphur contents of the concentrate. The sulphur, combined with the ammonia to form ammonium sulphate, will be crystallized and sold for use in fertilizers. The iron, which will be converted to oxide in the process, can be recovered, and investigations of possible uses for it in its finely divided form are now underway.

Sherritt Gordon spent $1,500,000 in research, and has been operating a pilot plant at Ottawa with 90 employees. Many of them have Ph. D. degrees, and they were drawn largely from among displaced persons from foreign countries. At one time seventeen nationalities were represented.

American Cyanamid spokesmen doubt that the adoption of the new process will immediately result in lower prices for metals because they are in such great demand. They do believe, though, that reduced treatment costs will make it profitable to extract ores that are now of too low a grade to be mined economically. In their words, "The era of chemical refinement of metals is beginning. A vast and challenging field lies ahead."

This and That

Compressed Air Protects Baby Foods

Ministering to American babies is a 5-billion-dollar annual business, according to an article in *Collier's* for May 3. The total bill has almost doubled since 1940, largely because the birth rate has increased: 3,900,000 babies were born in 1951. Each year American mothers buy 200 million dollars worth of foods that are prepared expressly for infant consumption. One concern, Gerber Products Company with three factories, processes baby foods exclusively and takes extreme care to prevent contamination, even surrounding each canning plant with a moat of DDT to control insects. Before cooking, fruits and vegetables are washed several times to remove insecticide residues, and cans or jars that are to receive the prepared products are blown out with compressed air and then washed. When filled, they are washed once more and dried with air under pressure.

★ ★ ★

Melting Metal in Suspension

If metal could be fused without contact with the crucible, a nearly pure product could be obtained—it could be rid of volatile impurities without absorbing others from the refractory materials. This sounds incredible, but it is actually being done on a laboratory scale with small samples of a limited number of metals, including aluminum.

When placed between two slightly conical horizontal coils of copper spaced a few inches apart and supplied with energy at 10,000 cycles, the metal literally floats into space midway between the coils after the switch is thrown and begins to boil turbulently, bobbing the while. Soon it glows red, starts to soften and then liquefies. As it does so it assumes the shape of a top spinning rapidly. When the current is turned off, the metal drops into a crucible, where it solidifies well-nigh instantly.

We are informed that this float metal is being used to advantage in studying materials for electronic tubes, lamps and other high-temperature applications, especially where it is not necessary to carry the temperature of the metal beyond its melting point. The investigations are being conducted by Westinghouse Electric Corporation.

"Yeah, maybe — but can it have colts like my old Betsy?"

★ ★ ★

Stonehenge Reveals Its Age

Knowledge gained from atomic-energy investigations has made it possible to determine the age of Stonehenge, the best example in Great Britain of prehistoric stone monuments. A few fragments of charcoal were the key that unlocked a secret that has bothered archaeologists for a long time. Eight months ago Prof. Stuart Piggott of Edinburgh University began a thorough survey of the area and found two holes that gave evidence of having been lodging places of some of the stones. One of them had been used as a ritual pit and contained bits of burnt wood. A sample was sent to Prof. W. F. Libby of the University of Chicago, who was able to estimate its age closely by the known rate of decay of the radioactive carbon it contained.

Professor Libby fixed the date at 1848 B.C., "plus or minus 275 years." This conforms rather closely to 1680 B.C., the date arrived at about 40 years ago by Sir Norman Lockyer, an archaeologist. Working on the assumption that the builders of Stonehenge were sun worshipers, he computed a date when the sun rose exactly over what he took to be the central sacrificial stone.

Stonehenge, near Salisbury, was originally a double circle of upright 20-foot-high stones, with some interior ones arranged in lines. It has never been learned who built the monument or why, and many who sought the answer have let their imaginations run rife. The name means "gallows cross," and some investigators believed the structure to be a Celtic gallows. Legends have attributed it to be the burial place of famous persons, including Emperor Constantine and Uther Pendragon, father of King Arthur. Its origin has been ascribed variously to peoples of the Stone, Bronze and Iron Age, to Danes, Celts, Romans and others. The latest information indicates that the charcoal was made late in the Bronze Age.

British students of such things will doubtless be glad that there is still dubiety about 550 years in Stonehenge's age. Speculating on just how old it is, and working up evidence to support their contentions, has been their favorite pastime, and even if Professor Libby's figure is accepted, his approximation still gives them more than half a millennium of uncertainty to argue over.

"Anybody seen the foreman?"

★ ★ ★

Economic Progress in 20 Years

The American workers' average wage more than doubled between 1929 and 1951 and their purchasing power rose 52 percent, according to the annual report of the Secretary of Labor. In 1929, up to then the peak year for production, the national output was worth 104 billion dollars and the average yearly wage was $1400. In 1950 the corresponding figures were 283 billion dollars and $3000. The value of farm production jumped from 14 billion to more than 33 billion dollars, and those of unincorporated enterprises, mostly small and medium-sized concerns, mounted from 8 billion to 24 billion dollars. The number of firms in business increased by one million during the two decades.

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Gravity Is Cheap Miner

Nature's old standby, the force of gravity, has been put to work deep beneath the earth's surface in a vast nickel-mining program at Copper Cliffs, Canada. It has provided the key for the recovery of millions of tons of ore that was once regarded as worthless. At its mines in the Sudbury District, The International Nickel Company of Canada, Limited, has recently applied a technique by which gigantic masses of ore, far underground, are induced to cave and disintegrate of their own weight.

Called "induced caving," this low-

cost bulk mining method, plus improved metallurgical practices, makes it practicable for Inco to recover and treat ore lower in grade than it has previously worked underground. In caving, a "slice" that may contain as much as 1,500,000 tons of ore is undercut. As the material underneath it is withdrawn, the slice breaks away and starts to disintegrate as it moves downward, the weight of the upper section acting to crush the bottom one. Another bulk mining method is the "blasthole" technique, which differs from caving only in that explosives are used to break the slice of harder, tougher ore from the solid material. The force of gravity then takes over, as in caving.

These methods are part of a development program, which has cost $130,000,000 to date, to shift from combined surface-and-underground mining to all underground mining. Upon its completion, the company will be able to hoist 13,000,000 tons of ore a year, and it will have the largest mining operation of its kind in the world. In expanding its underground workings, whole new areas have been developed for ore production, more than 70 miles of passages have been driven in solid rock, and four concrete-lined shafts, with an aggregate depth of 2 miles, have been sunk.

To increase facilities for metallurgical treatment of the ore, the company has built at the site of one of the new shafts a concentrator with a capacity of 10,000 tons a day, soon to be increased to 12,000 tons. The ore hoisted from the mine under push-button control is milled on the spot, and water is added to the concentrate to move it through a 7½-mile pipe line to the reduction plants at Copper Cliff.

For its enlarged operations, Inco has made tremendous installations of specialized equipment. Typical examples are crushers weighing 165 tons each and set up in vault-like chambers carved out of solid rock far underground; 20-ton electric locomotives and hundreds of large cars for hauling ore to crushers; and ventilation fans to supply an additional 1,250,000 cfm of fresh air to the workings.

Machine Speeds Foundry Coremaking

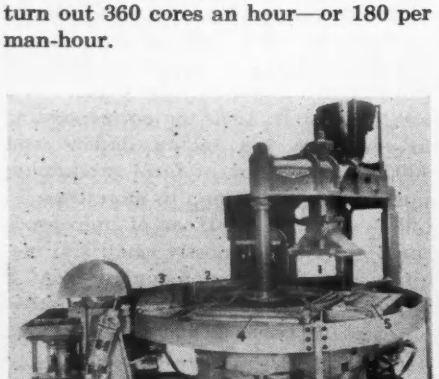
UTILIZING new equipment, cores for automotive castings are being made six times faster and also more accurately than they were by hand methods. The machine, designated as the Roto-Core Automatic and built by the Osborn Manufacturing Company, Cleveland, Ohio, depends largely on compressed air for its operation.

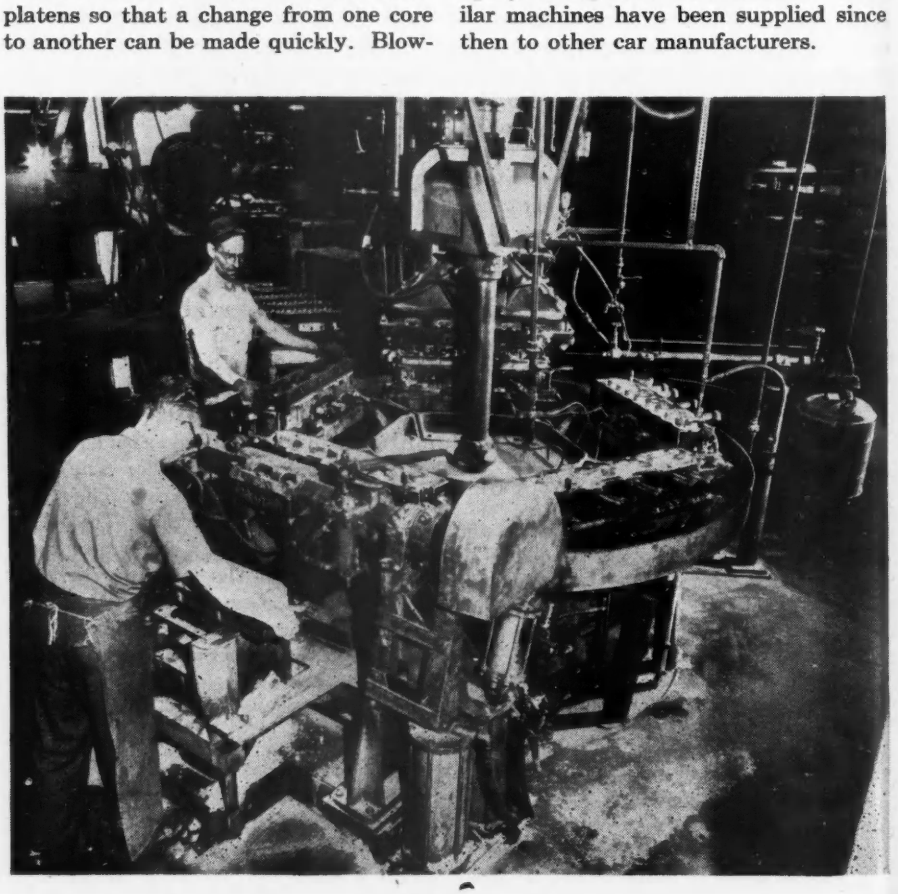
Under the old system, around 30 engine-block jacket cores were produced per man-hour. Three men were required: one at the core blower, another to carry core boxes to the blower, and a third to withdraw the core and put it on a conveyor running to the baking oven. With the Osborn contrivance, two men turn out 360 cores an hour—or 180 per man-hour.

The machine consists of a turntable having five stations: for blowing the core; for placing a drier plate on the finished core; the roll-over, where the core is taken from the overturned core box and placed on a conveyor; another where the box is blown clean; and the last, where loose pieces are automatically positioned for the next cycle. Indexing from station to station is done by a system of electrical controls. To protect the fragile cores from breakage that might be caused by sudden stops, all movements are gradually decelerated by an oil cushion at the indexer, which is ahead of the blowing station.

Core boxes are mounted on removable platens so that a change from one core to another can be made quickly. Blowing consists in driving prepared sand into a core box with compressed air at 125 psi pressure, which is the same as that needed for manually operated core blowers. Air is also used to actuate the cylinders that power the roll-over mechanism and for cleaning and spraying the core boxes.

Development of the machine was started in the spring of 1950, following a request from the Buick Division of General Motors Corporation for assistance in reducing the cost of preparing engine-block cores. A year later the first one was delivered. It has a capacity of 240 cores per hour, which Buick stepped up by adding several accessories. Similar machines have been supplied since then to other car manufacturers.



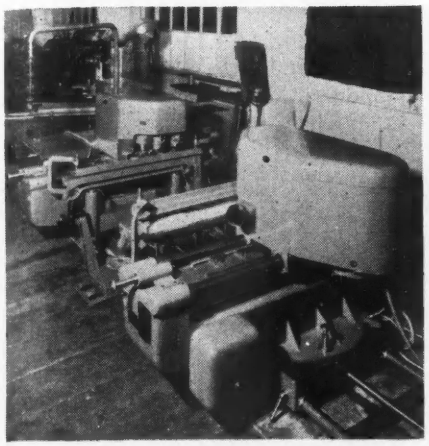


IN THE BUICK FOUNDRY

The numbers on the picture above indicate the five stations: 1, The core blower; 2, here a worker lays a drier plate on the finished core; 3, the roll-over draw where the core is taken from the core box and placed on a conveyor; 4, where the empty core box is automatically cleaned and sprayed with compressed air; 5, where the work of preparing the core box for another cycle is completed. The men shown in the operating view at the right are at stations 2 and 3. Buick uses this machine to produce cores for the intake manifold, block water jacket, and spring housing for the cylinder block.

Industrial Notes

An improved type of double-end tenoning machine of Swiss manufacture is being offered to the American furniture industry by Woodworking Precision Machinery & Tool Company, Inc. Named Tenko, it features a pneumatic clamp using air in the neighborhood of 15 psi which firmly holds the work throughout



its entire width while two moving heads with carbide tools cut grooves, tenons, etc. Each head has three sets of spindles: one set cuts the piece to the desired length and at the same time does whatever profiling, mitering and tenoning may be required; the two others, guided along by adjustable cams, cut interlocking tenons and grooves and do necessary shaping. The cutter units may be operated in parallel or, by simple adjustments, placed at an angle, an arrangement that makes for many types of joints. The finished work is said to be accurate to within 0.008 inch and ready for assembly as it comes from the machine. It takes pieces up to 3 feet wide, 8 feet long and from ⅜ inch to 2½ inches in thickness.

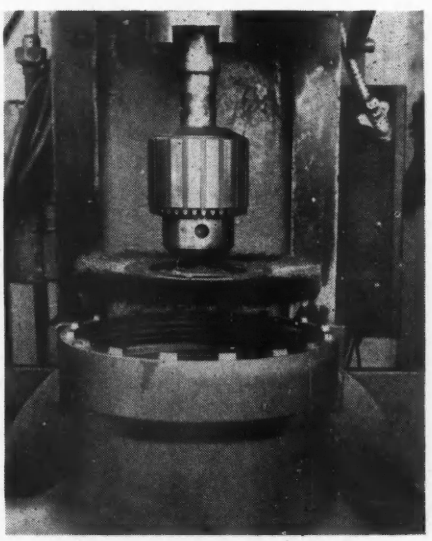
By means of a simple guide made from a 1¼-inch length of 1½-inch bar stock, the Texas Engineering & Manufacturing Company is trimming edges of aircraft skin sections flush with bolt angles at a greatly accelerated pace. The work was formerly done by a file, which often left uneven edges and sometimes damaged the bolt angle. Now the excess material is removed by a pneumatic hand router. The guide, according to the company, may be used for trimming operations other than those for which it was designed.

Drums of paper coated with Alathon, a du Pont polythene resin, were among the exhibits at the National Packaging Exposition held in April in Atlantic City, N. J. They are made of strips wound spiralwise and range in capacity from 12 to 75 gallons. Though not regarded as substitutes for metal containers, they are suitable for transporting and storing dry chemicals and other materials that cannot be shipped satisfactorily in conventional drums because of corrosion and moisture absorption. Experiments are now underway with similar containers for the handling of liquids and semiliquids.

Problems involved in melting metals —in some cases boiling at temperatures as high as 5000°F and at pressures as low as one-hundred thousandth of an atmosphere—have been solved, according to the National Research Corporation of Cambridge, Mass., thus making the commercial production of vacuum-cast, gas-free metals practicable.

It is reported that scratches as small as one-millionth of an inch on machined surfaces can be detected by an instrument developed by General Motors Corporation. Called the Surfagage, it has a diamond stylus. As the latter passes over the surface, its up-and-down movement is transformed into electrical signals which are recorded on a meter dial for measurement of roughness.

Because of the difficulty of finishing small bearing areas in the hubs of variable-pitch propellers, engineers of the Propeller Division of Curtiss-Wright, in coöperation with a brush manufacturer, rigged up an available machine that has not only solved the problem but saved the company an outlay of nearly $20,000 for special machinery and fixtures. The work, which involves removing high spots and pieces of fragmented metal



following shot-peening, is now done quickly and thoroughly by a drill press operated by a pneumatic ram and controlled by a timing device. Mounted in the chuck is a circular wire brush which revolves at 900 rpm, finishing the bearing surfaces and cleaning the threaded section as it is lowered and raised by means of the ram.

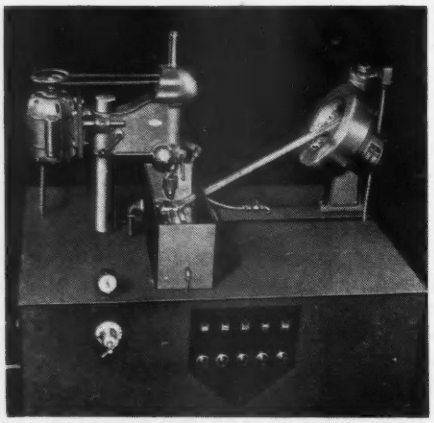
Mixing compressed air at 5 to 10 psi pressure with ordinary city gas has resulted in a cost-cutting soldering operation in an aircraft-parts plant. A circular table has been devised that holds eight to twelve work pieces and that revolves in predetermined increments. Preheating and soldering are done by two sets of burners: one that travels with the table, and a stationary set. The former preheats the part and carries it to the fixed burners which provide the fusing heat. Then the table returns to the starting position. Two men are used

for loading and unloading, and as many as 125 pieces have been soldered in an hour. Preheating is of importance in the manufacture of precision parts because there is less chance of structural deformity. The addition of air to the fuel raises the flame temperature to about 1300°F.

Highway vacuum cleaners of such power and proportions that they can pick up anything from tin cans to tree stumps are said to have undergone a successful 8-month test in the Los Angeles area. They are built by Good Roads Machinery Corporation.

As many as 832 strands of copper wire are braided into a ribbon that is bonded into the carcass of a new air hose made by Mercer Rubber Corporation to protect operators of pneumatic tools against shock should the hose come in contact with a power line. It is available in ½-inch size, inside diameter, in 4- and 5-ply construction.

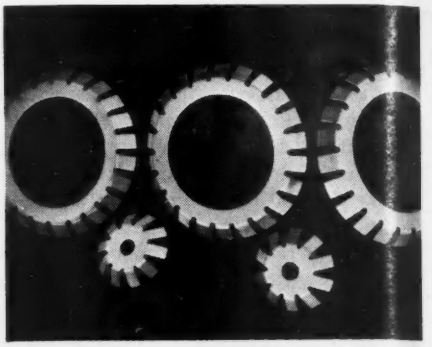
An ingenious machine has been devised by the Bowers Tool & Die Company to countersink simultaneously both ends of the center hole in wheels used on cigarette lighters of their manufac-

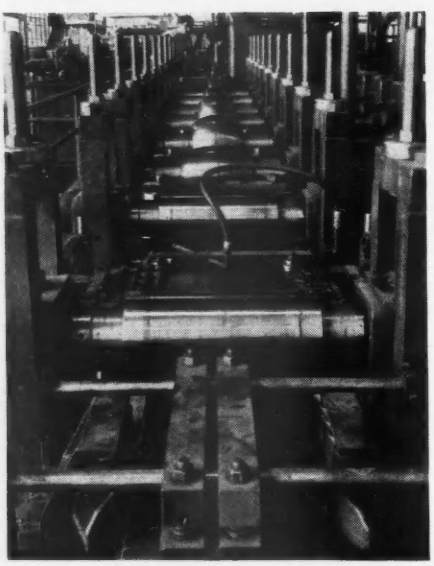


ture. The blanks are automatically fed from a rotary hopper and track into a pneumatic vise, where each is held while two drill presses, one above and the other below the worktable, countersink the holes. When the work is released, it is whisked away by an air jet. A single cam actuates the vise and ejector, as well as the feed to the two drill heads, thus insuring a completely coördinated operating cycle. Depth of the countersink is adjustable.

Plastic tubing for fluid, gas or low vacuum-pressure systems is offered by Hudson Industries, Inc. Trade-named Flexlite, it is said to have a tensile strength of 600 psi at 70°F, the strength increasing with decreasing temperature. Special fittings are provided, including a stainless-steel spring clamp that fits over the connections. Tubing now comes in ¼- and ⅜-inch sizes; larger diameters are to be made available later.

To combat leakage in hydraulic and pneumatic cylinders, pumps, compressors, feed mechanisms, lubricators, etc., HPL Manufacturing Company is offering a series of cup expanders, designated as ES-11, for use with all standard hydraulic and pneumatic packing diameters from 1¼ to 2⅞ inches. They complement the firm's line of strip ex-





GIANT TUBE MILL

Shown here is one of two big machines set up recently in the Mound Road plant of the Ford Motor Company for making tubing up to 5 inches in diameter from coiled steel fed automatically from huge drums at the loading end. As it moves along, the material is gradually shaped by the series of parallel rollers, welded and rid of flash. Next, the tubing is cut to length and annealed for final processing. The mill pictured is nearly 400 feet long and turns out 75 feet a minute for rear-axle housings. The other machine is 175 feet long and produces stock for driveshaft assemblies at the rate of 105 feet a minute. They are the result of three years of Ford engineering research and planning.

FASTER STOCKPILING at less cost... with a SAUERMAN SCRAPER

(Above) Storage and rehandling of thousands of tons of phosphate rock at large processing plant is accomplished by two Sauerman Drag Scraper units of medium size. Machine in foreground has its hoist mounted on a flat car, while the machine on opposite side of track uses a high head tower.

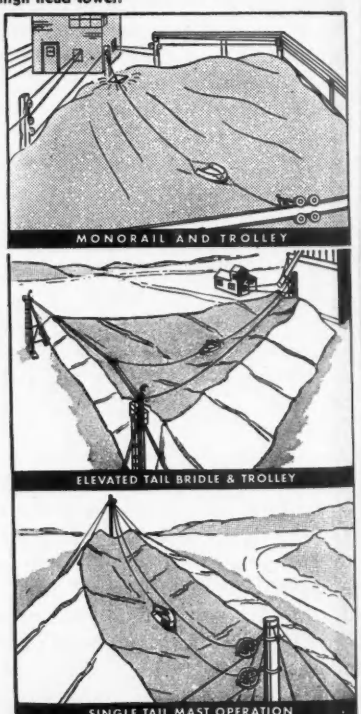
Whether the storage space is small or large—indoors or outdoors—whether the material is light or heavy—there is a type and size of Sauerman Drag Scraper to solve the problem and cut handling costs to rock bottom.

The Sauerman method is faster and more efficient because its operation is continuous and automatic—all under the finger-tip control of a single operator. The unique Crescent bottomless bucket quickly loads to capacity—slides smoothly over the top of the material being handled—empties cleanly and quickly when pull on cables is reversed.

The operating span may be any distance up to 1500 for the largest machines and up to 300 ft. for the smallest units.

Both initial cost and operating expense is moderate. The simple maintenance needs are economical. Diesel, gasoline or electric power consumption is small compared to tonnages handled.

Write for free illustrated Catalog E, "Bulk Storage By Power Scraper".



Above are three types of Sauerman Scraper Systems used to build economical stockpiles.

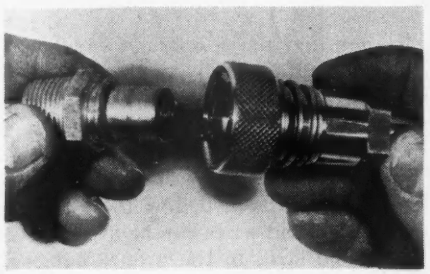
Rope Haulage Equipment Specialists Since 1909

SAUERMAN BROS., Inc.

548 S. Clinton St. Chicago 7, Ill.

panders for cylinder diameters greater than 3 inches. Made of specially rolled strip brass, they are easy to install and highly impervious to brine, gasoline and alcohol.

By redesigning the valve on its couplings for air hose, fuel lines between tanks and outboard-motor engines, water and paint lines, etc., and by using a square-cut synthetic-rubber gasket, E. B. Wiggins Oil Tool Company, Inc., has reduced the pressure drop by as much



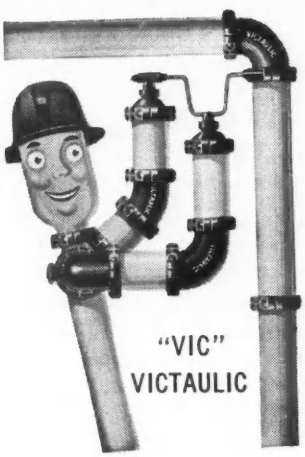
as 40 percent. It is also claimed that the coupling withstands temperatures ranging from minus 65° to plus 350°F. It can be connected or disconnected with the fingers and is self-sealing on the socket side when broken but can be made self-sealing on both sides. The coupling is currently being manufactured of aluminum alloy in pipe-size diameters from ⅛ inch to 1 inch. Company will furnish it in brass, carbon steel or stainless steel.

For pneumatic cylinders working in atmospheres made hazardous by dust or volatile gases, The Bellows Company has in production an electrically controlled explosionproof air-powered valve that is said to meet Group D, Class I Standards for wiring set by the National Board of Fire Underwriters. Designated as Model EXV 5A, it is a modification of the company's standard Electroaire valve and combines in one unit a 4-way directional slide valve, solenoid controls and piston-rod speed regulators. With

"A strike! Set 'em up in the other alley."

THE VICTAULIC® METHOD OF PIPING

EASIEST WAY TO MAKE ENDS MEET



The VICTAULIC METHOD is a *complete* line of Victaulic Couplings, Full-Flow Fittings and Vic-Groover Tools for mechanical piping construction. It's the easy way to hook-up pipe . . . it's fast and versatile . . . it's *complete and all-inclusive!* Use the VICTAULIC METHOD and you streamline piping . . . cut costs!

The Easy-to-use Victaulic Coupling . . . world-famous for quick, leak-proof connections . . . is the basic element of the VICTAULIC METHOD. For use with this coupling, Victaulic offers a complete line of top efficiency Full-Flow Elbows, Tees, Reducers and other Fittings . . . PLUS Vic-Groover Tools for preparing pipe ends easily and quickly right on the job!

Mis-alignments, expansion and contraction are automatically taken care of by Victaulic, locked-joint, leak-tight piping is assured. For new construction, repairs or alterations . . . for any piping job, big or small, the VICTAULIC METHOD *is the easiest way to make ends meet.*

The name VICTAULIC is more than a trademark . . . it stands for world leadership in a speedy, dependable piping method . . . backed by unexcelled engineering and years of proved experience. FOR YOUR OWN PROTECTION . . . be sure you get VICTAULIC!

Write today for Victaulic Catalog & Engineering Manual No. 44-8B

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Office and Plant: 1100 Morris Ave.
Union, N. J.
Telephone: Elizabeth 4-2141

28th VICTAULIC YEAR

California: Victaulic Inc., 727 W. 7th St., Los Angeles 14
Canada: Victaulic Co. of Canada Ltd., 406 Hopewell Ave., Toronto 10
Export: Pipe Couplings, Inc., 30 Rockefeller Plaza, N. Y. 20, N. Y.

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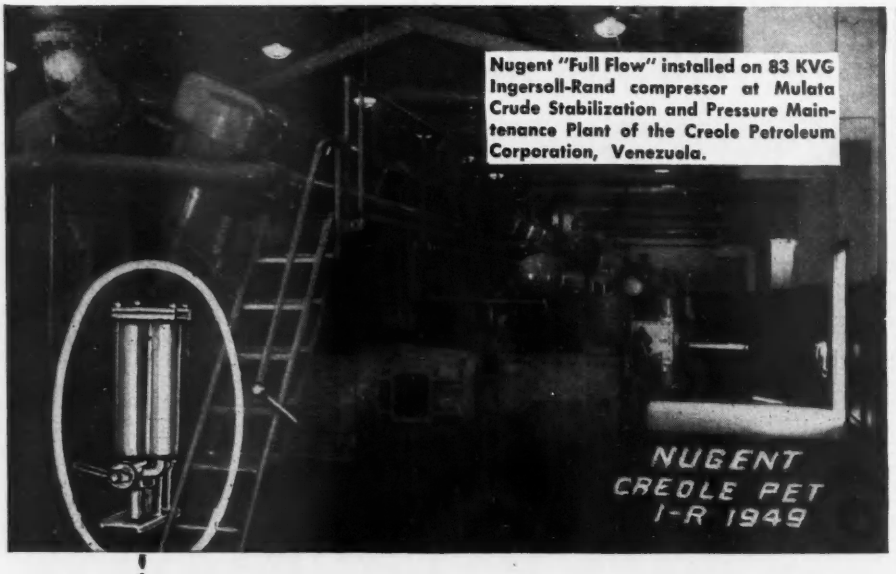
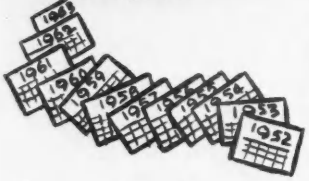


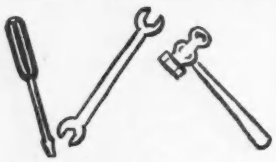
Nugent "Full Flow" installed on 83 KVG Ingersoll-Rand compressor at Mulata Crude Stabilization and Pressure Maintenance Plant of the Creole Petroleum Corporation, Venezuela.

● DON'T OVERLOOK THIS CRUCIAL POINT IN COMPRESSOR OPERATION

NUGENT FILTERING MEANS TRIPLE SAVINGS



Longer Machine Life



Less Maintenance

Less Oil Replacement

IT'S the lube oil filtering system, and it can play a big part in your profit and loss statement.

If you put a Nugent "Full Flow" filter in that spot you can be sure of stopping 99.8% of the harmful impurities that get into lubricating oil before they reach the vital working parts of the compressor. This is the kind of filtering that pays for itself many times over in oil savings, increased equipment life and reduced maintenance.

In Nugent "Full Flow Filtering" all the oil being circulated through your equipment is filtered every cycle. No part of the contaminated oil bypasses the filter. Dirt that is removed from the oil collects inside the special Nugent filter bags. When these bags fill up they can easily be cleaned and reused or new replacement bags are inexpensive. In addition, Nugent filter bags have 20 times more filtering capacity than others of comparable size.

Whatever type of machinery you use — compressors, gas engines or diesels — Nugent Filters can answer your filtering problems. There is a size and type for every need. Write for complete details.

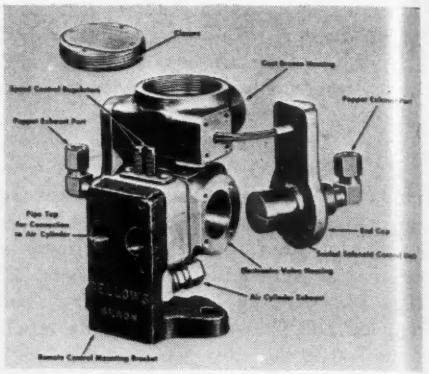
Wm. W. Nugent & Co., Inc.

472 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

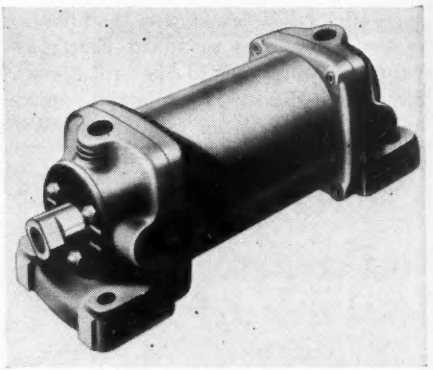
Established 1897

Representatives in Boston • Cincinnati • Dalvan • Houston • La Junta, Colo. • Los Angeles Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver



plungers that move only 1/32 inch, the tiny, sealed 8-volt solenoids serve as triggers to release the incoming high-pressure air on either side of a floating piston that operates the slide valve. These control units are attached to cast-bronze end caps drilled so their switching and ground wires can be attached to a terminal strip in the bronze housing. Two leads from a remote-control switch, carried through an electrical conduit, are fastened to the same strip. It is claimed that the solenoids will make up to 2200 movements a minute without interruption and without humming, pounding or overheating. All Bellows air cylinders in all bore sizes and mounting styles are available with built-in explosionproof Electroaire valves.

Rivett Lathe & Grinder, Inc., has announced a new line of air cylinders comprising 28 different models each available in nine bore diameters. The covers are held together by keeper rings instead of the conventional tie rods, a feature that permits rotating the covers to bring openings and fixed piping together and installing cylinders in restricted spaces.



The latter are produced in seven mounting styles in any length of stroke up to 96 inches and with single- or double-end rods, internal or external threads and with cushioned rod end, blind end, or both. The company recommends them for pressures up to 150 psi.

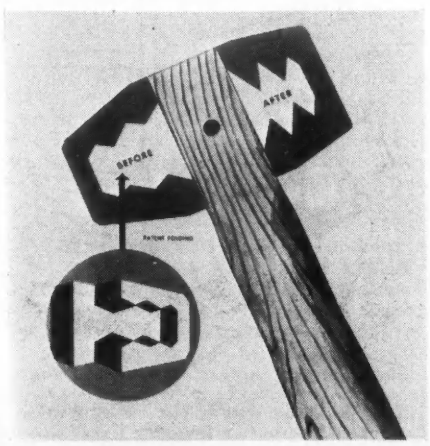
A direct-reading instrument that plainly indicates the humidity and temperature of the air to which it is exposed has been announced by the Abbeon Supply

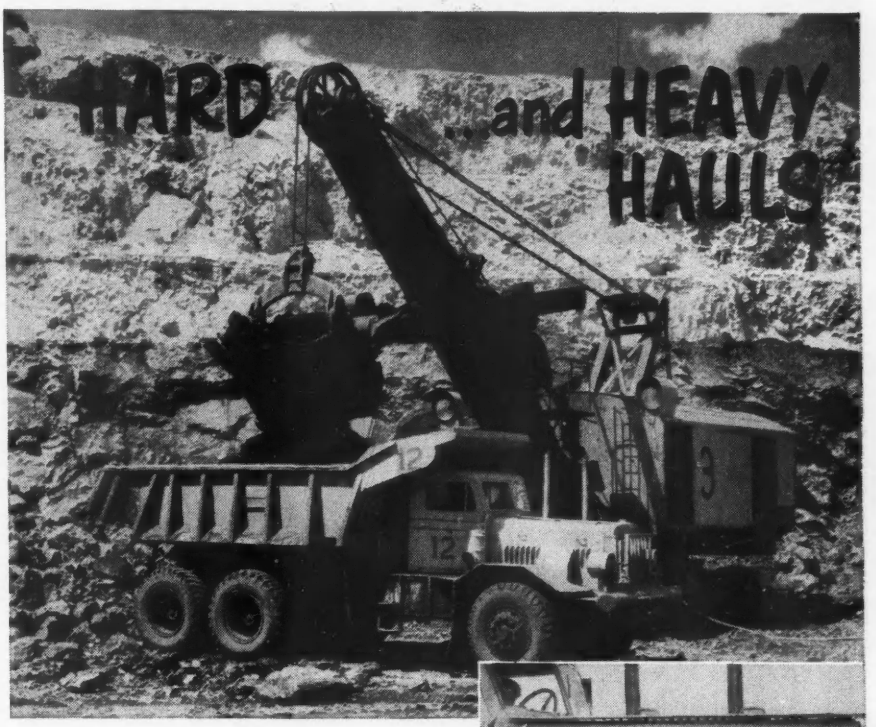
Company. The humidity-sensing element of the Model 186 Hygrodial, as it is called, is made of nine strands of blonde hair, which is said to be more sensitive than brunette or red hair to changes in atmospheric moisture content. Each strand contains three hairs, and there are 216 inches in the element. The instrument is said to be accurate

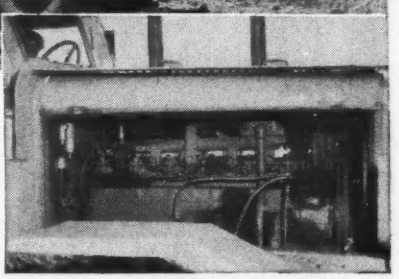
throughout the relative-humidity range from 0 to 100 percent and to within 1° at 70° and to 3° at the extremes of the 0 to 100°F temperature scale. With an over-all length of only 6 inches and a height of 4 inches, the indicator is in an attractive plastic case for desk use or wall mounting.

It is believed that air conditioning will render the new 51,500-ton superliner *United States* free of seasickness. A spokesman for the York Corporation, which supplied the equipment, points out that this illness is commonly brought on or aggravated by food odors, which will be absent throughout substantially the entire ship.

And now there is a malleable hammer built on the "controlled-compression principle." Called the Flex-Flo, it has a metal head with inner chambers that have corrugated walls, as the accompanying picture shows. Under continuous pounding, the opposing angles of these corrugations slowly approximate each other at a predetermined rate, thus retarding compression of the malleable head and preventing mushrooming. It is further claimed that the hammer won't spark, chip or flake—will retain its orig-



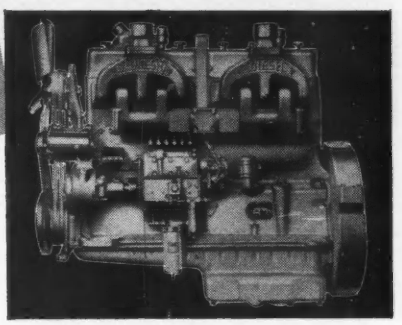




PAYLOAD POWER

WAUKESHA

Diesel

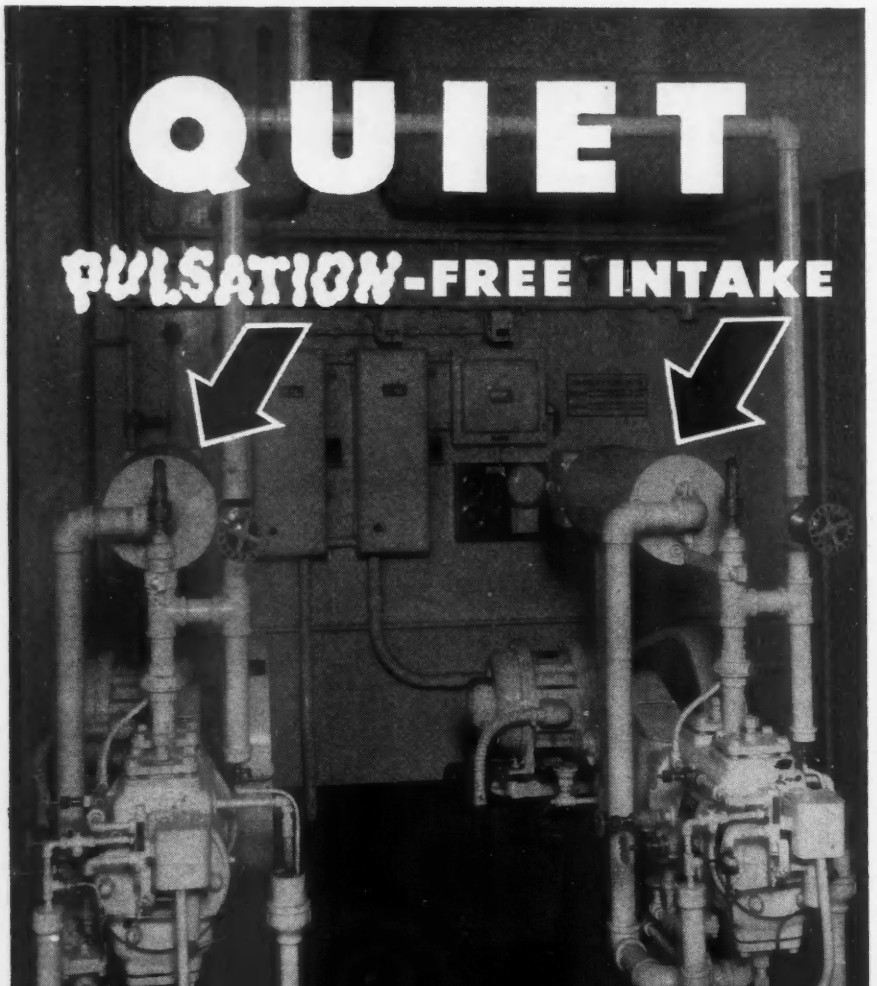


WAKD Super-Duty DIESEL
—Six cylinders, 6¼-in. bore x 6½-in. stroke, 1197 cu. in. displ.

• Where the digging is toughest and where the hauling is heaviest, and hardest... where turns twist, and grades are steep and stiff—Waukesha Super-Duty Diesels take the jobs through, and come back for more. The truck shown hauls an average payload of 30 tons at an elevation of 6400 feet from a quarter to a half mile 16 hours a day. It makes about 38 trips a day. Waukesha has put all this payload performance into its Diesels—by 25 years of Diesel development and research—with many exclusive Waukesha features. The patented spherical combustion chamber controls combustion to meet operation needs—giving the engine lively responsive acceleration, smoothness and complete clean burning for high fuel economy and low maintenance. For the *how* and *why* Diesel details, send for Bulletin 1415.

174

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN
New York • Tulsa • Los Angeles



with

MAXIM SILENCERS

● Maxim makes silencers for compressor intake, vacuum pump discharge, blower intake or discharge, internal combustion engine exhaust or intake, high velocity steam, air or gas discharges, spark arresting and heat recovery silencers.

Consult **MAXIM**

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Gentlemen: Please send me your bulletin on silencers for
☐ Compressor Intake ☐ Internal Combustion Engines
☐ Steam Blow-off ☐ Spark Arresting ☐ Heat Recovery.

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Company _____

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4MX52

inal balance and weight—because it is made of a special nonferrous, copper-base alloy. The new soft hammer is a product of the Custanite Corporation and comes in six weights ranging from ¾ pound to 6 pounds.

Operators of a multiple-spindle press can certainly take their ease, for they have been provided with seats, with comfortable foot rests, that enable them to roll from one work station to another.

Automatic fire extinguishers, if they are to provide real protection, should be corrosion and rustproof in any climate or under any atmospheric conditions. In answer to these requirements, Red Comet, Inc., has developed a unit

called Safety Spray, which has a tough nonflammable plastic case with cadmium-plated metal parts. The fire-killing agent is carbon tetrachloride sealed in a glass container to prevent evaporation. The latter is broken by a spring-propelled plunger when heat frees a fusible clip. The released chemical, which has a boiling point of only 168°F, quickly vaporizes to envelope and smother the flames.

"Heck, this ain't the blueprint. It's the wife's grocery list."

Industrial Literature

A new circular published by Kato Engineering Company, 1415 First Avenue, Mankato, Minn., gives information on the company's general line of generators, motor-generators, converters, and power plants. Copies are available upon request.

The design and manufacture of small precision tools to customer specifications is the business of Woodruff & Stokes Company, Inc., 349 Lincoln Street, Hingham, Mass. It offers free a new 18-page catalogue, No. 20, which describes its complete line.

Two-drum boilers, designed to provide maximum capacity where floor space and head room are limited, are featured in a new well-illustrated 16-page bulletin published by Henry Vogt Machine Company, Inc., 10th & Ormsby Streets, Louisville 10, Ky. Copies of the publication, titled *Bent Tube Boilers*, are available on request.

If you are looking for information on roof repairing or resurfacing by a cold process you can obtain two folders from The Hallemite Manufacturing Company, 2446 W. 25th Street, Cleveland, Ohio, that will tell you in detail how to lay a 1- or 2-ply roof and to give it a waterproof coating.

Bulletin No. 34, obtainable from American Ventilating Hose Company, Inc., 100 Park Avenue, New York 17, N. Y., deals with the firm's lightweight flexible ducting bearing the trade name Flexaust. In addition to giving general information about the hose and its accessories, the publication lists and illustrates typical uses.

Ways and means of guarding against damage, if not panic, from smoke introduced accidentally into the intakes of air-conditioning systems is the subject of Bulletin 521 just released by ESS Instrument Company, 96 S. Washington Avenue, Bergenfield, N. J. It describes and gives installation diagrams of the firm's three types of smoke detectors which automatically cut off the circulation of air when the smoke reaches a predetermined density.

Logan Engineering Company, 4901 W. Lawrence Avenue, Chicago 30, Ill., has announced a new catalogue on its Aridifier, a device for removing moisture, scale and other foreign matter from compressed-air and other gas lines. It shows the structural features of the unit and how it operates, gives installation diagrams, and includes information on how to select an Aridifier suitable for a given capacity. Request Catalogue 252 when writing for a copy.

Commercial Filters Corporation, 18 W. Third Street, Boston 27, Mass., is distributing a 4-page folder on its standard line of Fulflo filters for microscopic clarification of industrial liquids and gases. It contains the data engineers need to select a unit for a given application and gives detailed information about the single- and multiple Honeycomb filter tubes used. The latter range in capacity from 6 to 60,000 gph. Ask for Catalogue PL-200.

Power transmission with leather belting is an interesting subject comprehensibly dealt with in a 40-page catalogue and manual being distributed by Graton & Knight Company of Worcester, Mass. In addition to showing the types and grades of belts manufactured, the booklet contains information on the choice, care and operation of leather belts, charts and tables showing horsepower ratings and belt speeds and

Familiar Scenes
IN MINING SERVICE

Tailings Line by NAYLOR

Its light weight makes Naylor Pipe easier to handle and install. Its exclusive structure makes it stronger and extra safe in the rugged service required for tailings lines and other mining applications. Along with these advantages, Naylor provides the one-piece Wedge-Lock Coupling that speeds connections and simplifies installation of the line. No wonder scenes like this are so familiar throughout the industry.

Write for Bulletin No. 507

Naylor Pipe Company
1245 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

other valuable data. Users or buyers of belting, or designers of equipment requiring power transmission, will find the publication a valuable addition to their files. Ask for Catalogue No. 101.

With the nonferrous scrap campaign getting underway, The Aluminum Association, 420 Lexington Avenue, New York 17, N. Y., has issued a timely publication called *Conservation of Aluminum*. Besides dealing with the proper handling of scrap, the booklet discusses the efficient use of available supplies of this strategic metal. Write the association for copies of the 8-page publication.

The A. F. Holden Company, 11300 Schaefer Highway, Detroit 27, Mich., manufacturer of heat-treating baths and furnaces, has prepared a bulletin on carburizing and tempering baths. It includes charts showing case depths at various times and temperatures, fuel savings possible with carbon blankets and the amount of salt that should be added periodically to balance bath and maintain operating efficiency. It also contains instructions on how to control distortion to less than 0.001 inch.

Users of overhead or bridge-type cranes with 4-rope bucket trolleys may be interested in a profusely illustrated 44-page bulletin, No. 2392, recently published by Blaw-Knox Company, Pittsburgh 30, Pa. It gives detailed information about the different types of buckets available; about reeving, cable arrangements and sheave bearings; contains numerous installation views; and features a list of ten vital points that will enable prospective purchasers to prepare an inquiry for a bucket.

Operators or prospective users of surface grinding machines should be interested in a new manual offered by Norton Company, Worcester 6, Mass. Titled *The ABC of Surface Grinding*, it contains information on how to select the right wheel for a given job, what difficulties to expect, many grinding hints, as well as short cuts recommended by experienced grinding men and machine builders.

Sterling Electric Motors, Inc., 5401 Anaheim-Telegraph Road, Los Angeles 22, Calif., gives complete descriptive information on its variable-speed drives, geared motors and constant normal-speed motors in dripproof, splashproof, totally enclosed and pipe-ventilated designs in a recently published 20-page catalogue that is available by applying to any of the company's sales offices or authorized distributors.

An 8-page bulletin descriptive of its improved Staynew ventilation and air-conditioning filters has been announced by Dollinger Corporation, 11 Centre Park, Rochester 3, N. Y. It contains specifications and engineering and performance data on various filters of this type designed for the removal of dust and other foreign matter by the impingement method. Ask for Catalogue 100.

Periodically every business is faced with the problem of destroying old and unwanted records and safely storing those that must be retained. Remington Rand, Inc., 315 Fourth Avenue, New York 10, N. Y., has planned a system whereby management can perform this necessary work at a saving in cost. The system is described in a 21-page booklet titled, *A Basic Plan for Record Retention and Destruction*, which the company is distributing free of charge.

Illustrated Bulletin 5452 of the Hagan Corporation, Hagan Building, Pittsburgh 30, Pa., describes its improved Ratio Totalizer. It is a pneumatically operated control mechanism suitable for combining input control pressures and spring forces and producing an output control pressure based on addition, subtraction, multiplication, division or more complicated functions of the input control signals. A copy of the descriptive 8-page booklet can be obtained by writing the company.

Donaldson Field Engineers *Cover the Continent*

on your Air Cleaner and Muffler Problems!

These men are on *our* payroll, but they work for *you*. Their job is to make sure that *your* equipment stays properly protected against dust, or that Donaldson Mufflers continue to do their job. Highly unusual conditions of climate, dust or geography that create problems requiring on-the-spot study, take them to every corner of the continent.

Donaldson Field Service is an important part of the Donaldson Engineering Program. It is included in the Donaldson "follow-through-service" package which starts with an analysis of your air cleaner or muffler requirements and continues throughout the operating life of your equipment.

DONALDSON COMPANY, INC.

666 Pelham Blvd., St. Paul 4, Minnesota

Donaldson Co. Ltd. (Canada), Chatham, Ontario

IRON MINE—Donaldson engineers developed a new, quieter, long-life muffler for ore trucks.

WHEAT FIELD—Installed pre-screener to eliminate entrance of chaff to induction system.

WESTERN HIGHWAY—Installed larger cleaner to handle over-run condition.

Donaldson AIR CLEANERS MUFFLERS

"Amazing, isn't it, what a couple of hundred thousand tons of steel can do?"